A1-F18AC-630-100

1 May 1986

Change 2 - 1 August 1992

TECHNICAL MANUAL

ORGANIZATIONAL MAINTENANCE
PRINCIPLES OF OPERATION

DATA LINK, INSTRUMENT LANDING, AND RADAR BEACON SYSTEMS

NAVY MODEL
F/A-18A AND F/A-18B
161353 AND UP

This manual is incomplete without A1-F18AC-630-110/(C).

Published by Direction of the Commander, Naval Air Systems Command

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0801LP6636812

NATEC ELECTRONIC MANUAL

NUMERICAL INDEX OF EFFECTIVE WORK PACKAGES/PAGES

List of Current Changes

Original 0 . . . . . 1 May 86
Change 1 . . . . . 1 Nov 90
Change 2 . . . . . 1 Aug 92

Only those work packages assigned to the manual are listed in this index. Insert Change 2, dated 1 August 1992. Dispose of superseded work packages/pages. Superseded classified work packages/pages shall be destroyed in accordance with applicable security regulations. If changed pages are issued to a work package, insert the changed pages in the applicable work package. The portion of text affected in a changed or revised work package is indicated by change bars or the change symbol "R" in the outer margin of each column of text. Changes to illustrations are indicated by pointing hands, change bars, or a MAJOR CHANGE symbols. Changes to diagrams may be indicated by shaded borders.

The total number of pages in this manual is 124 consisting of the following:

WP/Page Number	Change Number
Title	2
A	2
TPDR-1	2
TPDR-2 blank	2
001 00	
1	2
2 blank	2
002 00	
1	2
2	2
3	2
4	2
5	2
6	2
7	2
8 blank	2
003 00	
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2	2
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9	0
10	0
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12	0
13	0
14	0
15	0
16	1
17	0
18	0
19	0
20	0

LIST OF TECHNICAL PUBLICATION DEFICIENCY REPORTS INCORPORATED

ORGANIZATIONAL MAINTENANCE

PRINCIPLES OF OPERATION

DATA LINK, INSTRUMENT LANDING, AND RADAR BEACON SYSTEMS

This WP supersedes TPDR WP, dated 1 November 1990.

1. The TPDRs listed below have been incorporated in this issue.

IDENTIFICATION NO./ QA SEQUENCE NUMBER	LOCATION
Note: NAMTRAGRUDET-1038 0025/80404	Previously incorporated in WP010 00, change 1 dated 1 November 1990 as 0404/0025.

ALPHABETICAL INDEX

ORGANIZATIONAL MAINTENANCE

PRINCIPLES OF OPERATION

DATA LINK, INSTRUMENT LANDING, AND RADAR BEACON SYSTEMS

This WP supersedes WP001 00, dated 1 November 1990.

INTRODUCTION

ORGANIZATIONAL MAINTENANCE

PRINCIPLES OF OPERATION

DATA LINK, INSTRUMENT LANDING AND RADAR BEACON SYSTEMS

This WP supersedes WOO2 00, dated 1 **November** 1990.

1. PURPOSE.

2. This manual provides the technician with a general understanding of how the various components function in the system.

3. REQUISITIONING AND DISTRIBUTION OF NAVAIR TECHNICAL PUBLICATIONS.

4. Procedures to be used by Naval Activities and other Department of Defense organizations requiring NAVAIR technical publications are defined in the NAVAL AIR SYSTEMS COMMAND TECHNICAL MANUAL PROGRAM manual, NAVAIR 00-25-100 and NAVAIRINST 5605.5, Distribution of aeronautic technical publications. To automatically receive future changes and revisions to NAVAIR technical manuals, an activity must be established on the Automatic Distribution Requirements List (ADRL) maintained by the Naval Air Technical Services Facility (NAVAIRTECHSERVFAC). To become established on the ADRL, notify your activity central technical publications librarian. If your activity does not have a library, you may establish your automatic distribution requirements by contacting the Commanding Officer, NAVAIRTECHSERVFAC, Attn: ADRL REQUEST, 700 Robbins Avenue, Philadelphia, PA 19111-5097. Annual reconfirmation of these requirements are necessary to remain on automatic distribution. Please use your NAVAIRTECHSERVFAC assigned account number whenever referring to automatic distribution requirements.

If additional or replacement copies of this manual are required with no attendant changes in the ADRL, they may be ordered by submitting a DD 1348 requisition directly to the Commanding Officer, Naval Publications and Forms Center, 5801 Tabor Road, Philadelphia, PA 19120-5099.

5. CONTENT.

6. Work packages contain description and operation of systems, subsystems, and components. The text is supported by component locators, block diagrams and simplified schematics.

7. COMPONENT LOCATOR. The component locator shows aircraft component location. The illustration shows the technicians view when possible.

8. BLOCK DIAGRAMS. Block diagrams consist primarily of blocks connected by lines. These diagrams portray the function of a system or subsystem.

9. SIMPLIFIED SCHEMATICS. Simplified schematics consist primarily of blocks connected by single lines with limited use of symbols and pictorial drawings of units. These schematics simplify system functions as much as possible. All schematics are shown with electrical power off, switches in off positions, and relays in deenergized position unless noted on schematic.

10. SCHEMATIC HIGHLIGHTS.

11. For schematic highlights see figure 1.

12. MANUAL ISSUE DATE.

13. The date on the title page is the copy freeze date. No additions, deletions, or changes are made after the manual issue date except last minute safety of flight or required maintenance changes.

Data collected after the manual issue date will be included in later changes or revisions of the manual.

14. EFFECTIVITIES.

15. Effectivity notes on manual title pages, work package title pages, and within a work package indicate the aircraft or software program to which the data applies. If no effectivity note appears on the work package title page, the work package has the same effectivity as shown on the manual title page The effectivity notes may use:

NOTE

Aircraft with model designator F/A-18B are the same type and model as TF/A-18A.

a Type, model, and series

b. Bureau number (tail number)

c. Combination of type, model, series, and bureau numbers

d. Part number or serial number

e. Technical directive number

f. Configuration/identification number

16. The table below shows examples of effectivity notes and their meanings:

Effectivity Note Examples

Effectivity Note	Definition
160777 AND UP	Applicable to all F/A-18A, F/A-18B, F/A-18C and F/A-18D for bureau numbers listed.
F/A- 18A, F/A- 18B	Applicable to all F/A-18A and F/A-18B.
F/A- 18C, F/A- 18D	Applicable to all F/A-18C and F/A-18D.
F/A-18A	Applicable to all F/A-18A, but not' F/A-MB, F/A-18C and F/A- 18D.
F/A- 18B	Applicable to all F/A-18B, but not F/A-18A, F/A-18C, and F/A- 18D.
F/A- 18C	Applicable to all F/A-18C, but not F/A-18A, F/A-18B, and F/A- 18D.
F/A- 18D	Applicable to all F/A-18D, but 'not F/A-18A, F/A-18B, and F/A: 18C.
F/A- 18A, F/A- 18C	Applicable to all F/A-18A and F/A-18C, but not to F/A-18B and F/A- 18D.
F/A- 18B, F/A- 18D	Applicable to all F/A-18B and F/A-18D, but not to F/A-18A and F/A-18C.
F/A-18A 160775, 160777 THRU 160782	Only applicable to some bureau numbers of F/A-18A. Not applicable to any F/A-18B, even if a F/A-18B bureau number is within the numbers listed.

Effectivity Note Examples (Continued)

Effectivity Note	Definition
F/A-18C 163427, 163430 THRU 163456	Only applicable to some bureau numbers of F/A-18C. Not applicable to any F/A-18D, even if a F/A-18D bureau number is within the numbers listed.
F/A-18B 160784 AND UP	Only applicable to some bureau numbers of F/A-18B. Not applicable to any F/A-18A, even if an F/A-18A bureau number is within the numbers listed.
F/A-18D 163434 THRU 163457	Only applicable to some bureau numbers of F/A-18D. Not applicable to any F/A-18C, even if a F/A-18C bureau number is within the numbers listed.
166775 THRU 160785 BEFORE F/A-18 AFC 772	Applicable to F/A-18A and F/A-18B for bureau numbers listed, before modification by technical directive.
161213 AND UP; ALSO 169775 THRU 160785 AFTER F/A-18 AFC 772	Applicable to aircraft modified during production; also applicable when affected aircraft have been modified by technical directive.
169775 THRU 160785; WHEN NO. 2 CONTROL PANEL P/N XXXX-X IS INSTALLED	Applicable to F/A-18A and F/A-18B for bureau numbers listed if panel P/N XXXX-X is installed. (Configuration before AVC)
161213 AND UP; ALSO 169775 THRU 166785; WHEN NO. 2 CONTROL PANEL P/N XXXX-Y (AVC-102) IS INSTALLED	Applicable to aircraft modified during production; also applicable to aircraft components modified to the production configuration by technical directive. (Configuration after AVC)
P/N MBEU65101-9, MBEU65101-10 & MBEU65105-3	Applicable to assemblies which are interchangeable between aircraft.
ENGINE NO. 215101 THRU 215109	Applicable to assemblies which are interchangeable between aircraft, but configurations can not be identified by part number.
CONFIG/IDENT NUMBER 84A	The CONFIG/IDENT number is the program load identification number which identifies the software program loaded in specific programmable units. Refer to A1-F18AC-SCM-000 for CONFIG/IDENT number tables.

17. **TECHNICAL DIRECTIVES.**

18. Technical directives are documents which direct the accomplishment, and recording of a retrofit configuration or inspection to delivered aircraft, or aircraft components.

19. **AIRFRAME CHANGE (AFC) AND AIRBORNE TACTICAL SOFTWARE CHANGE (ASC)** . Technical directives which change configuration of aircraft structure or equipment installation, i.e. AFC, will list aircraft bureau numbers in effectivity notes and show before and after the AFC. Technical directives which change configuration of operational flight programs (OFP), i.e. ASC, will list the OFP CONFIG/IDENT NUMBER in effectivity notes and show the latest two authorized OFP programs. See AFC and ASC effectivity examples in Effectivity Note Example Table.

20. AIRCRAFT COMPONENT CHANGES. Technical directives which change configuration of aircraft components, i.e. AAC, ACC, AVC, AYC, and PPC will list part numbers in the effectivities. See AVC effectivity examples in Effectivity Note Example table.

21. RECORD OF APPLICABLE TECHNICAL DIRECTIVES.

22. The technical directives affecting this manual are listed in the Record of Applicable Technical Directives of each affected work package. Because an ASC directs all aircraft be modified within 30 days, ASC's are not listed. When all affected aircraft are modified, the before configuration is removed from the manual, and the technical directive entry is removed from the Record of Applicable Technical Directives.

23. TECHNICAL PUBLICATIONS DEFICIENCY REPORT (TPDR).

24. The TPDR (OPNAV FORM 4790/66) is the form for reporting errors and suspected omissions in the technical manuals. Reporting procedures are in OPNAVINST 4790.2 SERIES.

25. DIAGRAMS.

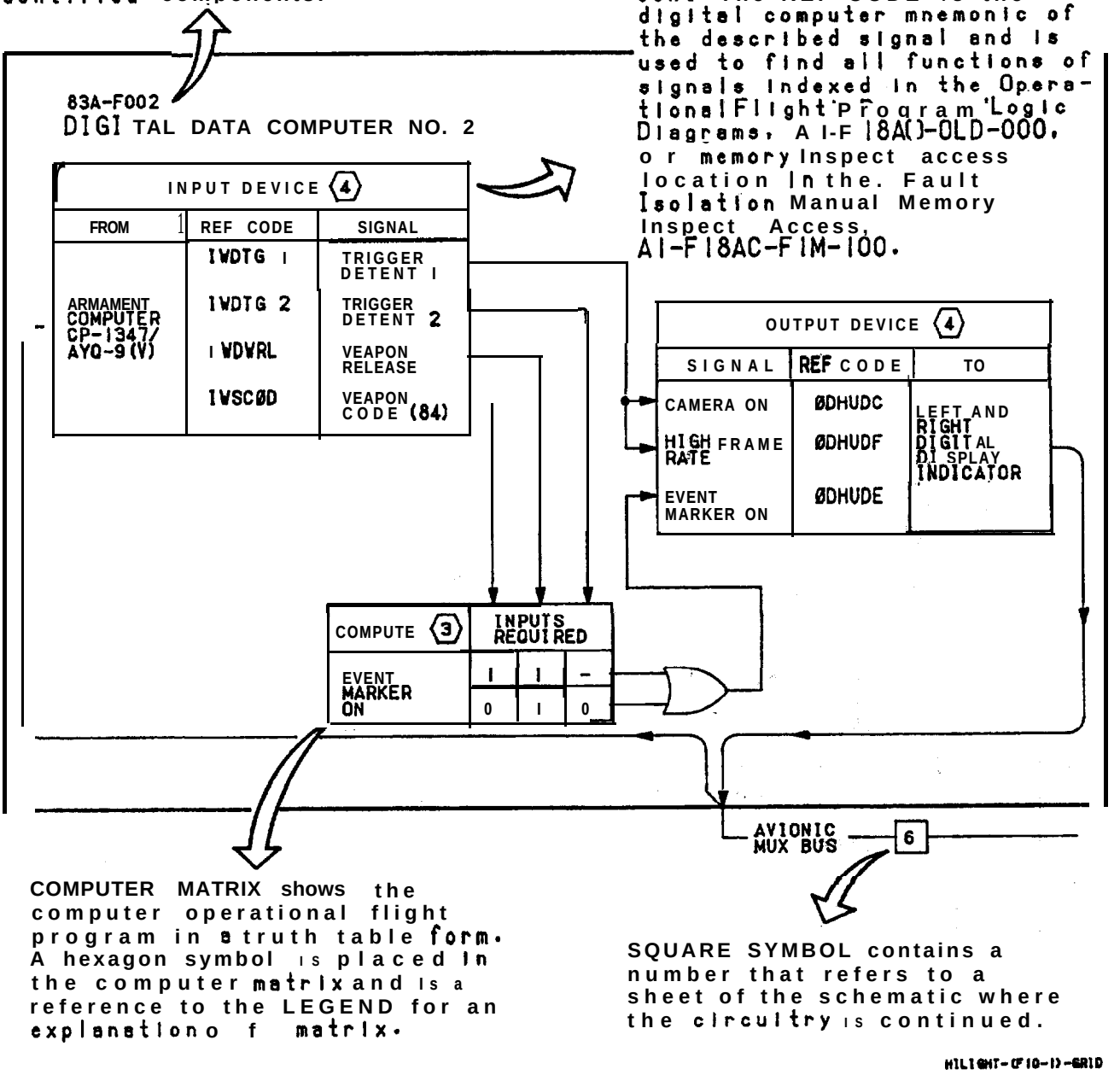
26. Simplified schematics and block diagrams are in this manual. System schematics are in A1-F18A( )-(j-500 series manuals.

27. NAVY (AN) STANDARD/ COMMON NAME NOMENCLATURE.

28. When an item has both Navy (AN) standard and common name nomenclature assigned, the common name nomenclature will be used in text and on illustrations. Full Navy (AN) standard nomenclature will be used in the Illustrated Parts Breakdown (IPB).

83A-F002 is the reference designation for Digital Data Computer No. 2. Reference designations are used to aid in identifying and locating components. A numerical index of reference designations in the Parts List Index, A1-F18AC-IPB-450, lists all reference designations assigned to electronic, electrical, and mechanical parts of the aircraft. When reference designations are known, the index can be used to find part numbers and to locate specific maintenance instructions for identified components.

INPUT OR OUTPUT DEVICE describes the signal, tells where signal comes from or to what component signal is sent. The REF CODE is the digital computer mnemonic of the described signal and is used to find all functions of signals indexed in the Operational Flight Program Logic Diagrams, A1-F18AC-OLD-000, or memory Inspect access location in the Fault Isolation Manual Memory Inspect Access, A1-F18AC-FIM-100.



COMPUTER MATRIX shows the computer operational flight program in a truth table form. A hexagon symbol is placed in the computer matrix and is a reference to the LEGEND for an explanation of matrix.

SQUARE SYMBOL contains a number that refers to a sheet of the schematic where the circuitry is continued.

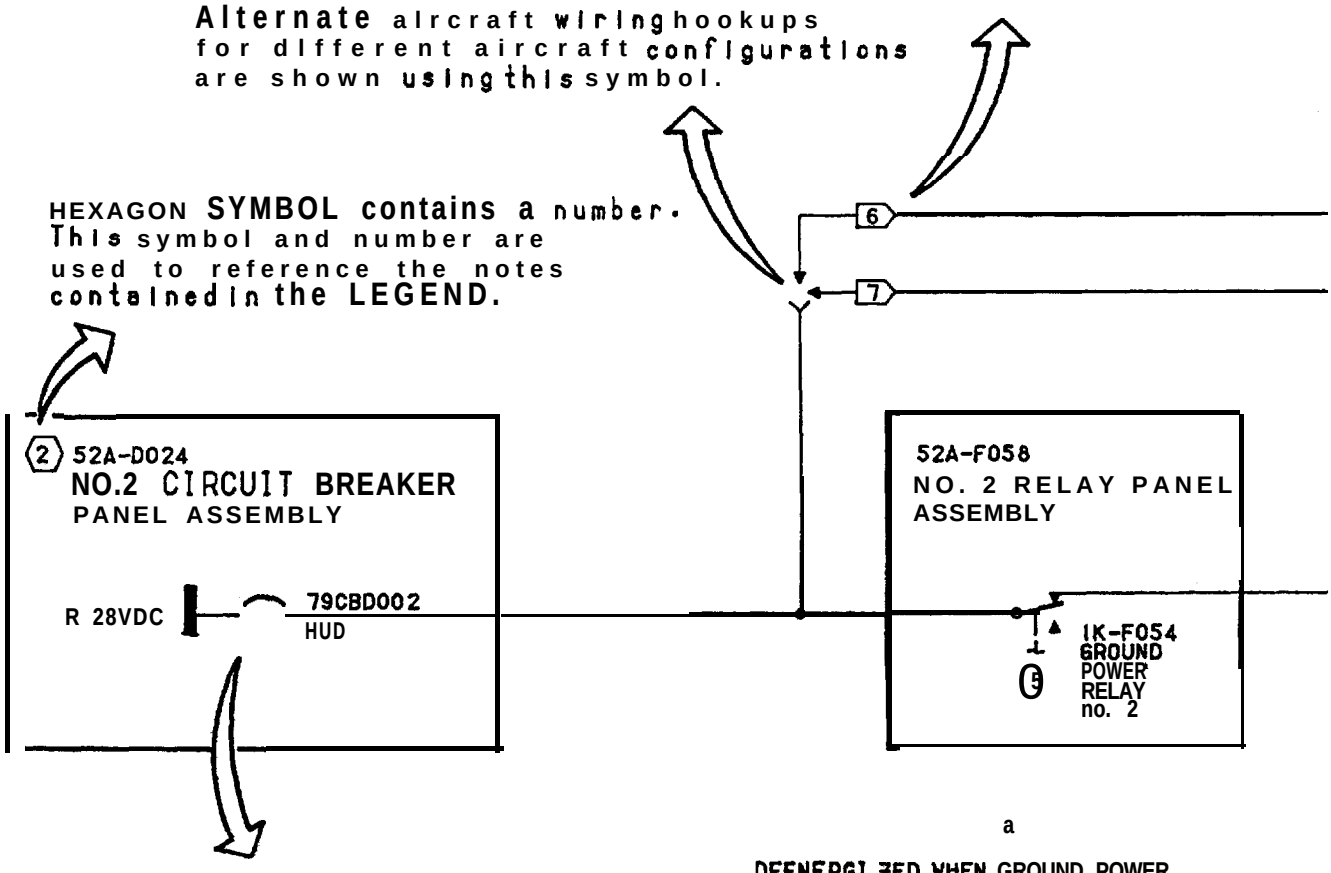
HILIGHT-(F18-1)-GRID

Figure 1. Schematic Highlights (Sheet 1)

FLAG SYMBOL contains a number. This symbol and number are used to reference the notes contained in the LEGEND.

Alternate aircraft wiring hookups for different aircraft configurations are shown using this symbol.

HEXAGON SYMBOL contains a number. This symbol and number are used to reference the notes contained in the LEGEND.



Information pertinent to circuit breaker is shown on schematics as listed below:

- R 28VDC is the aircraft bus which supplies voltage to circuit breaker.
- 79CBDDD2 is the reference designator for circuit breaker end is located next to breaker on rear of panel.
- HUD is the name of circuit breaker snd is located next to breaker on front of panel.

a

DEENERGIZED WHEN GROUND POWER 2 SWITCH IS IN B ON. EXTERNAL ELECTRICAL POWER IS NOT APPLIED, OR APU IS NOT IN GROUND MAINTENANCE MODE.

a

Operation highlights give pertinent information about the operation of the circuit, for ease of signal tracing.

HILIGHT-(F10-2)-GRID

Figure 1. Schematic Highlights (Sheet 2)

The legend contains all notes pertinent to the schematic as listed below:

NUMBER listed with no symbols is general information about the schematic.

NONSTANDARD SYMBOLS appearing on schematic. ere shown or referenced with an explanation.

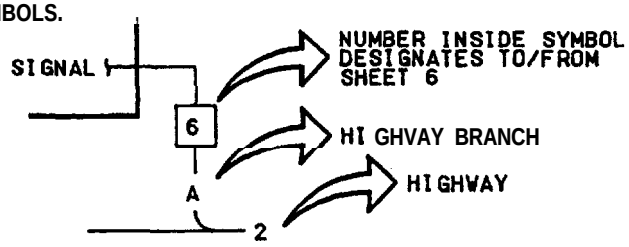
ABBREVIATIONS appearing on schematic are shown or referenced with en explanation.

HEXAGON SYMBOL refers to anothar schematic or manual for continuation of a circuit or an explanation of data contained on schematic.

FLAG SYMBOL indicates limited aircraft application.

LEGEND

1. NONSTANDARD SYMBOLS.



(2) POVER DISTRIBUTION SYSTEM SIMPLIFIED SCHEMATIC. A1-F18AC-420-100. VP005 00.

(3) EXPLANATION OF MATRIX

A. COMPUTE COLUMN LISTS THE SIGNAL OUTPUT.

B. INPUTS REQUIRED ARE USED TO DEVELOP THE SIGNAL OUTPUT.

C. THE SIGNAL OUTPUT IS READ HORIZONTALLY. EACH HORIZONTAL LINE IS AN INDEPENDENT SIGNAL OUTPUT.

D. INTERPRET MATRIX TABLE AS INDICATED:

(1) ONE (1) INDICATES THIS INPUT AS NAMED MUST BE THERE TO GET THE OUTPUT.

(2) ZERO (0) INDICATES THIS INPUT AS NAMED MUST NOT BE THERE TO GET THE OUTPUT.

(3) DASH (-) INDICATES THE OUTPUT DOES NOT DEPEND ON THIS INPUT.

(4) FOR LOGIC DIAGRAMS RELATING TO REF CODE. REFER TO A1-F 18AC-OLD-000. FOR MEMORY INSPECT ACCESS LOCATION RELATING TO REF CODE. REFER TO A1-F18AC-FIM-100.

(5) GROUND POVER SWITCHING SIMPLIFIED SCHEMATIC. A1-F18AC-420-100. VP005 00.

(6) F/A-18A.

(7) F/A-18B.

HILIGHT-(F10-3)-GRID

Figure 1. Schematic Highlights (Sheet 3)

ORGANIZATIONAL MAINTENANCE

PRINCIPLES OF OPERATION

DESCRIPTION - SYSTEM

INSTRUMENT LANDING SYSTEM

This WP supersedes WP003 00, dated 1 November 1990.

Reference Material

Alphabetical Index

Record of Applicable Technical Directives

None

1. INTRODUCTION.

2. Information for the instrument landing system (ILS) description is divided as listed below:

a. system description

b. component description

c. controls and indicators

3. SYSTEM DESCRIPTION.

4. The instrument landing system (ILS) is an all weather approach guidance system. The ILS operates along with an Electronic Guidance Transmitting Set AN/TRN-28 ground installation or aircraft carrier installed Aircraft Approach Control with Transmitting Set AN/SPN-41.

5. The ILS provides steering information during an aircraft approach by decoding azimuth and elevation microwave signals. The decoded signals are used for display on the head-up display unit (HUD) and the attitude reference indicator (ARI). On aircraft WITH DIGITAL DATA COMPUTER CONFIG/IDENT 89A AND UP, steering information can also be displayed on the electronic ADI display.

6. COMPONENT DESCRIPTION.

7. The ILS is made up of:

a. Radio Receiver

b. Pulse Decoder

c. KU-Band Antenna

d. KU-Band Waveguide Assembly

For locator, refer to WP004 00.

8. **RADIO RECEIVER**. Azimuth and elevation information signals are received from the surface transmitter. The Radio Receiver (receiver) mixes, detects, and amplifies these signals to provide an information coded pulse train to Pulse Decoder. The receiver has a BIT module for system BIT testing.

NOTE

R-1379A/ARA-63 is compatible only with KY-651A/ARA-63. R-1379B/ARA-63 is compatible only with KY-651B/ARA-63.

9. **PULSE DECODER.** The decoded signals are used for azimuth and elevation steering displays on the HUD and ARI. The receiver output signals are received and decoded by the Pulse Decoder (decoder) for azimuth and elevation information. The decoder also provides warning signals when azimuth or elevation steering is not valid.

10. The decoder has BIT circuitry for system BIT testing. On the back of the decoder is a glide slope adjustment switch. The glide slope must be set to 3° to pass BIT, but can be adjusted from 2° to 5° in 0.5° increments.

11. **KU-BAND ANTENNA.** Azimuth and elevation signals from the surface transmitter are received by the KU-Band Antenna.

12. **KU-BAND WAVEGUIDE ASSEMBLY.** Azimuth and elevation signals from the KU-band antenna to the receiver are transmitted by the KU-band waveguide assembly.

13. CONTROLS AND INDICATORS.

14. See table 1. Refer to WP004 00 for locator.

Table 1. Controls and Indicators

Control/Indicator	Function
1. GND PWR control panel assembly	
a. 1 switch	When in A ON, applies power to digital data computer No. 1. For other systems powered by 1 switch, refer to ground power switching description (A1-F18AC-420-100, WP005 00)
b. 2 switch	When in B ON, applies power to the control-converter (supplies decoder ON signal when the ILS is turned on from the electronic equipment control. For other systems powered by 2 switch, refer to ground power switching description (A1-F18AC-420-100, WP005 00).
c. 4 switch	When in A ON, applies power to intercommunication amplifier-control. For other systems powered by 4 switch, refer to ground power switching description (A1-F18AC-420-100, WP005 00).

Table 1. Controls and Indicators (Continued)

Control/Indicator	Function
2. Electronic equipment control (fig 1)	
a. ON/OFF switch	Turns ILS system on or off after first pressing ILS function select switch.
b. ILS function select switch	Enables ILS CHNL option to be displayed on option display and ILS status (ON/OFF) and channel to be displayed on scratch pad display.
c. Option display	
(1) CHNL	Indicates that last ILS channel entered into control-converter memory has automatically been selected and entered on scratch pad display.
(2) MAN	Indicates that the ILS is operating in the backup mode. Displayed when ILS function select is pressed and ILS UFC/MAN switch is set to MAN on intercommunication amplifier-control.
d. Keyboard	Used to display ILS channel number on scratch pad display and for entry into control-converter memory.
e. Scratch pad display	Indicates ILS status (ON/OFF) and ILS channel being used.
3. Left digital display indicator (fig 1)	
a. MENU pushbutton switch	Provides MENU display.
b. MENU display	Provides control for selection of displays on left digital display indicator.
(1) BIT pushbutton switch	Provides BIT control display.
(2) HSI pushbutton switch	Provides HSI display. For description of display, see horizontal indicator.
(3) ADI pushbutton switch	WITH DIGITAL DATA COMPUTER CONFIG/IDENT 89A AND UP, steering information can also be displayed on the electronic ADI display.Provides electronic attitude reference indicator with localizer and glideslope needles when ILS is selected and receiving valid signals. horizontal indicator.
c. BIT control display.	Provides control for selecting BIT test of ILS.

Table 1. Controls and Indicators (Continued)

Control/Indicator	Function
(1) ILS/AUG/BCN/D/L pushbutton switch	Starts BIT test of ILS.
(2) ILS BIT status	Displays ILS BIT status-IN TEST, GO, DEGD, NOT RDY, and RESTRT.
4. Right digital display indicator (fig 1).	Provides same functions as described for left digital display indicator.
5. Horizontal indicator (fig 1).	
a. HSI display:	Provides navigation information and steering mode selections for display on head-up display unit (HUD).
(1) ILS pushbutton switch	Enables azimuth and elevation steering information from digital data computer No. 1 to be displayed on HUD.
(2) ACL pushbutton switch	Turns on ILS system when data link system is operating in the ACL mode.
6. Head-Up Display Unit (fig 1).	
a. ILS steering display	Displays azimuth and elevation steering when ILS is selected on HSI display.
7. Intercommunication amplifier-control.	Selects source of control for ILS.
a. ILS UFC/MAN switch	When in UFC position, ILS power and channel is controlled by electronic equipment control. When in MAN position, ILS power is enabled by the Intercommunication Amplifier-Control.
b. ILS CHANNEL select switch	Select ILS channel when ILS UFC/MAN switch is in MAN position.
8. Attitude Reference Indicator.	Displays ILS azimuth and elevation steering.
9. Rear Attitude Reference Indicator F/A-18B	Provides pitch and roll information only. No ILS steering is displayed.
10. Radio Receiver	
a. Fault indicator	Normally black and white. Latches to all white when receiver fails.
11. Pulse Decoder	
a. Fault indicator	Normally black and white. Latches to all white when decoder fails.

Table 1. Controls and Indicators (Continued)

Control/Indicator	Function
b. Glide slope adjustment switch	Controls the glide slope of the ILS.
12. Digital Display Indicator	
a. WPN SYS FAIL indicator	Latch type fault indicator. Sets to fault (black and white) when failed unit maintenance codes are stored in nose wheelwell DDI.
b. MAINTENANCE CODE display	Three digit light-emitting diode display. Displays maintenance codes stored in nose wheelwell DDI when MAINTENANCE CODE DISPLAY switch is pressed. Maintenance code of 148 indicates ILS failure.

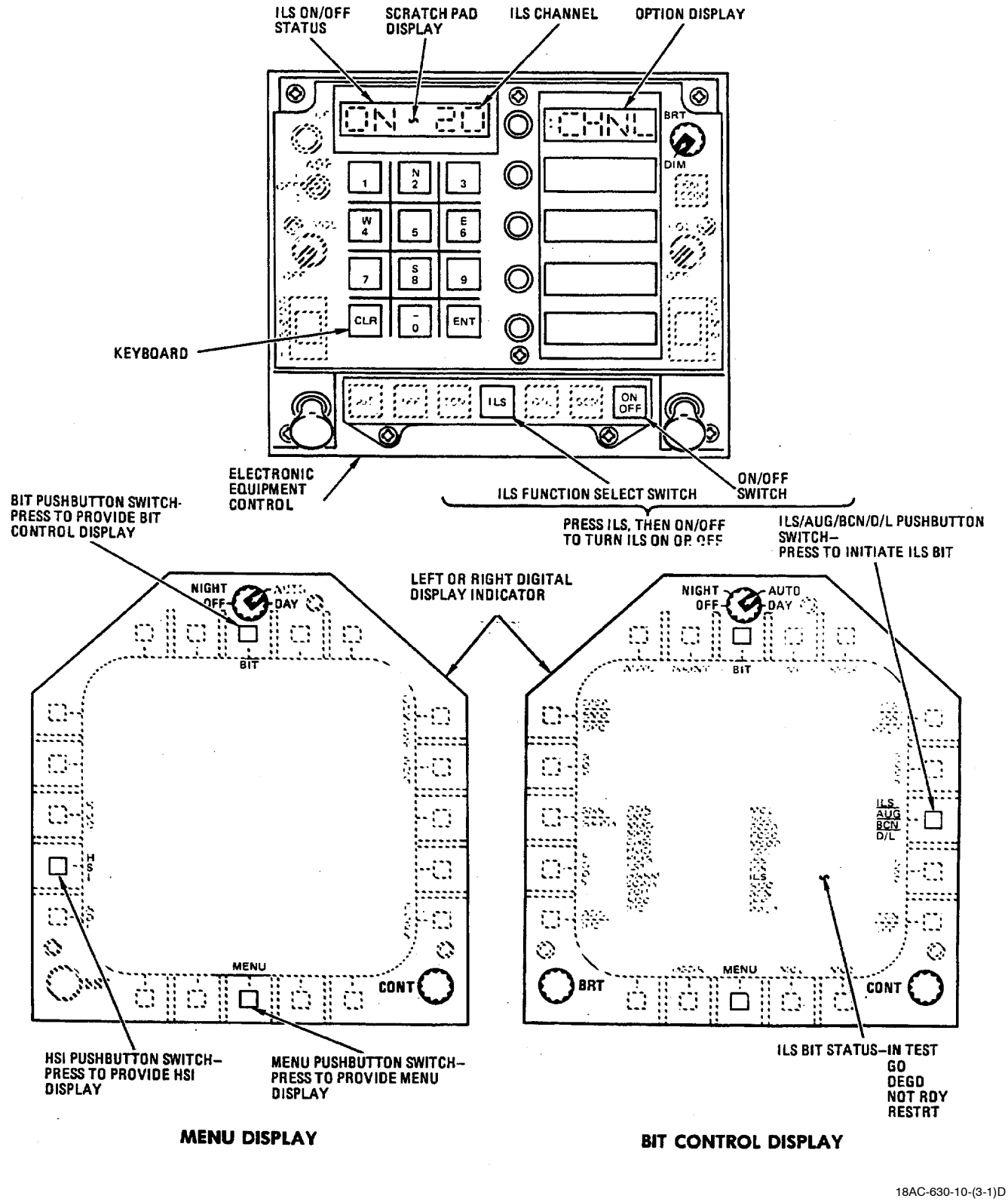


Figure 1. Cockpit Displays (Sheet 1)

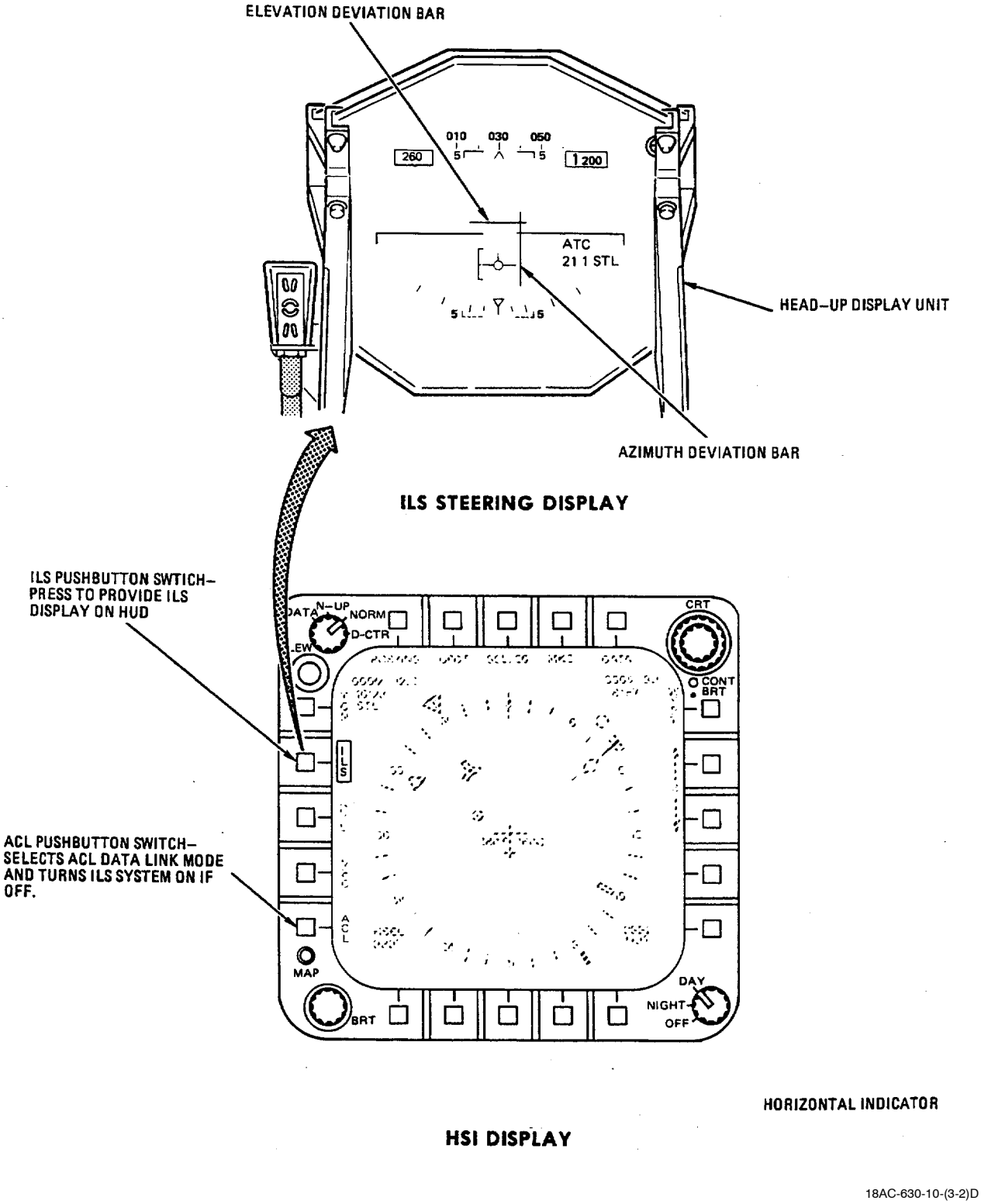


Figure 1. Cockpit Displays (Sheet 2)

ORGANIZATIONAL MAINTENANCE

PRINCIPLES OF OPERATION

LOCATOR

INSTRUMENT LANDING SYSTEM

This WP supersedes WP004 00, dated 1 May 1986.

Reference Material

None

Alphabetical Index

Record of Applicable Technical Directives

None

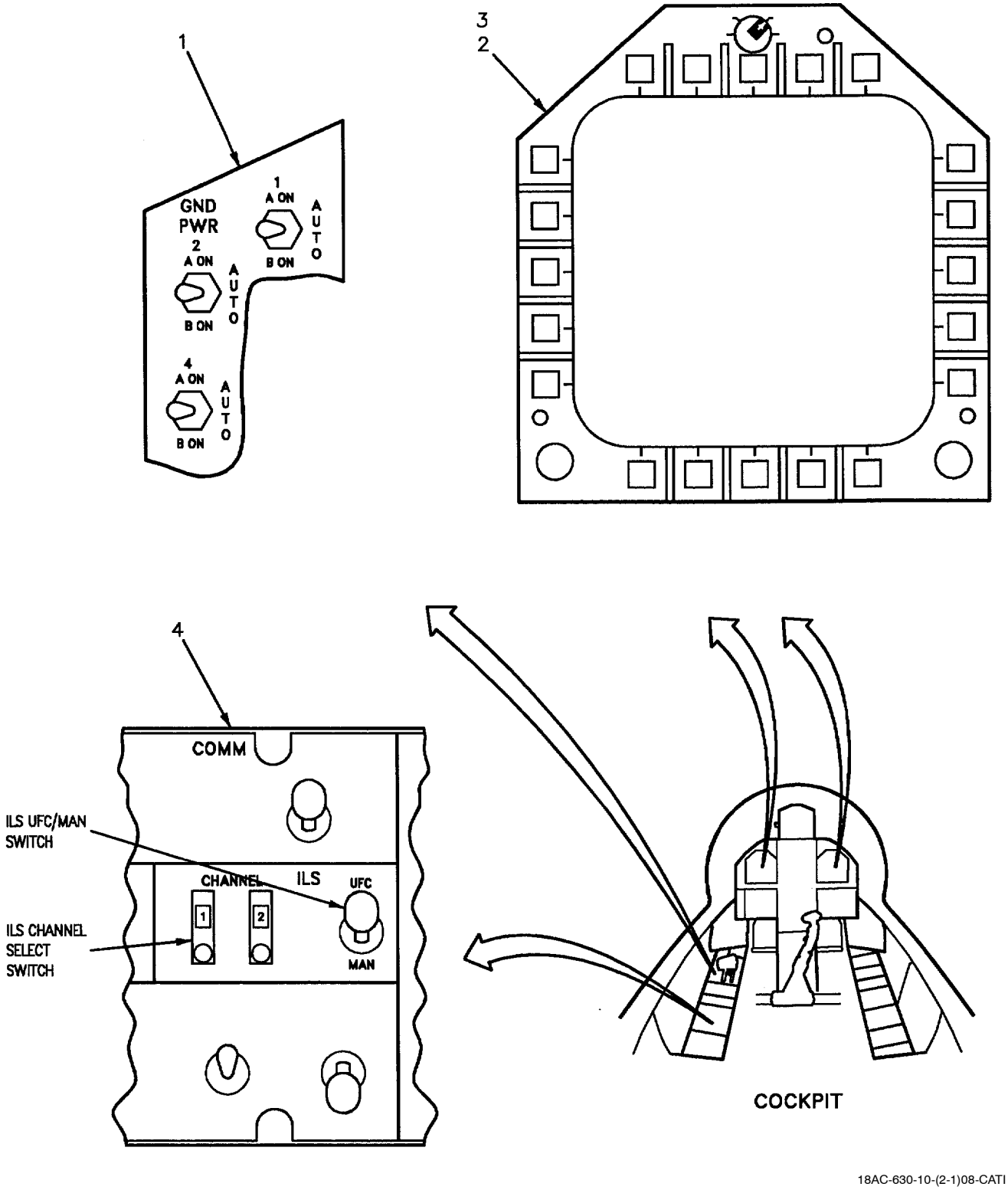


Figure 1. ILS Locator (Sheet 1)

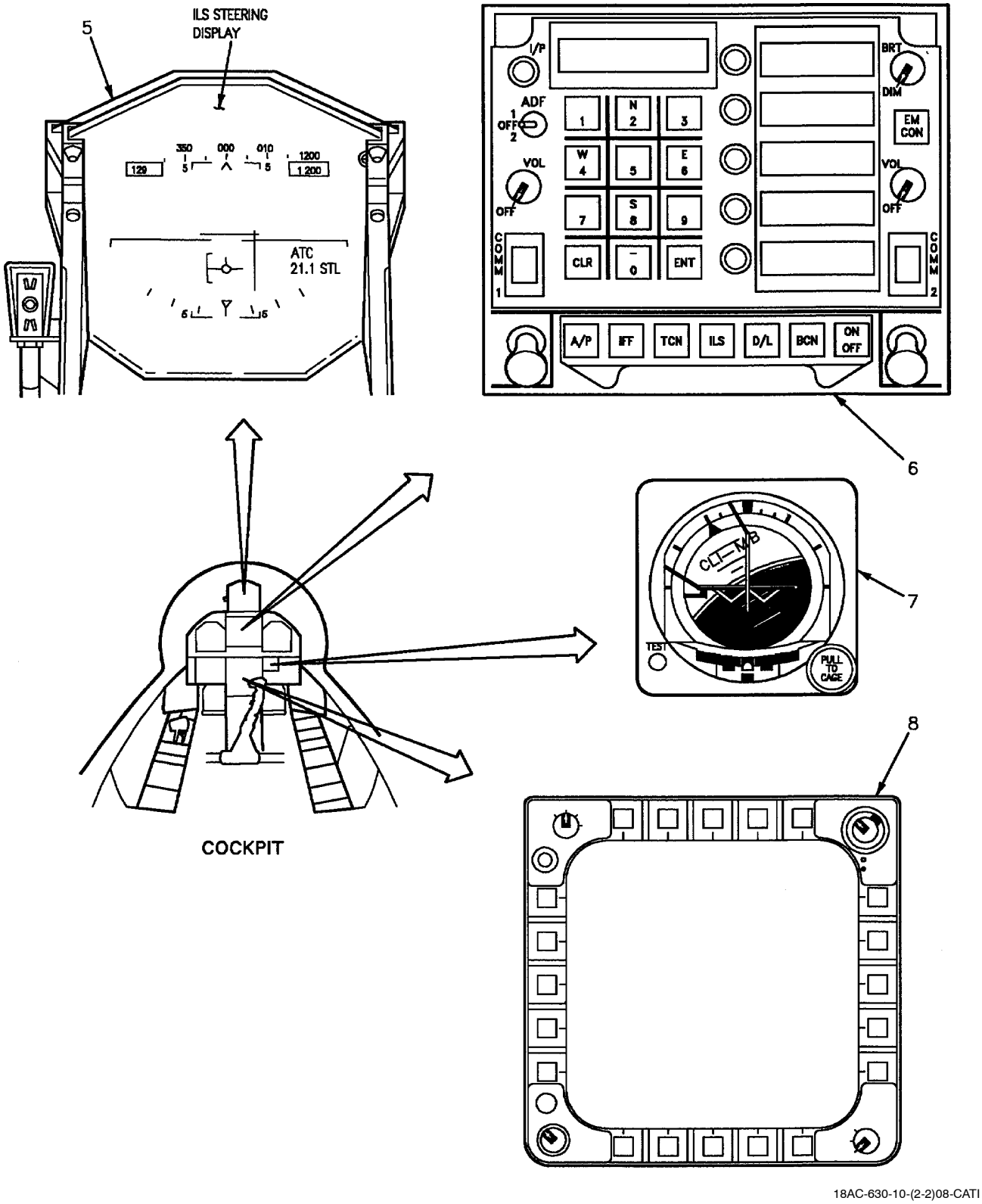


Figure 1. ILS Locator (Sheet 2)

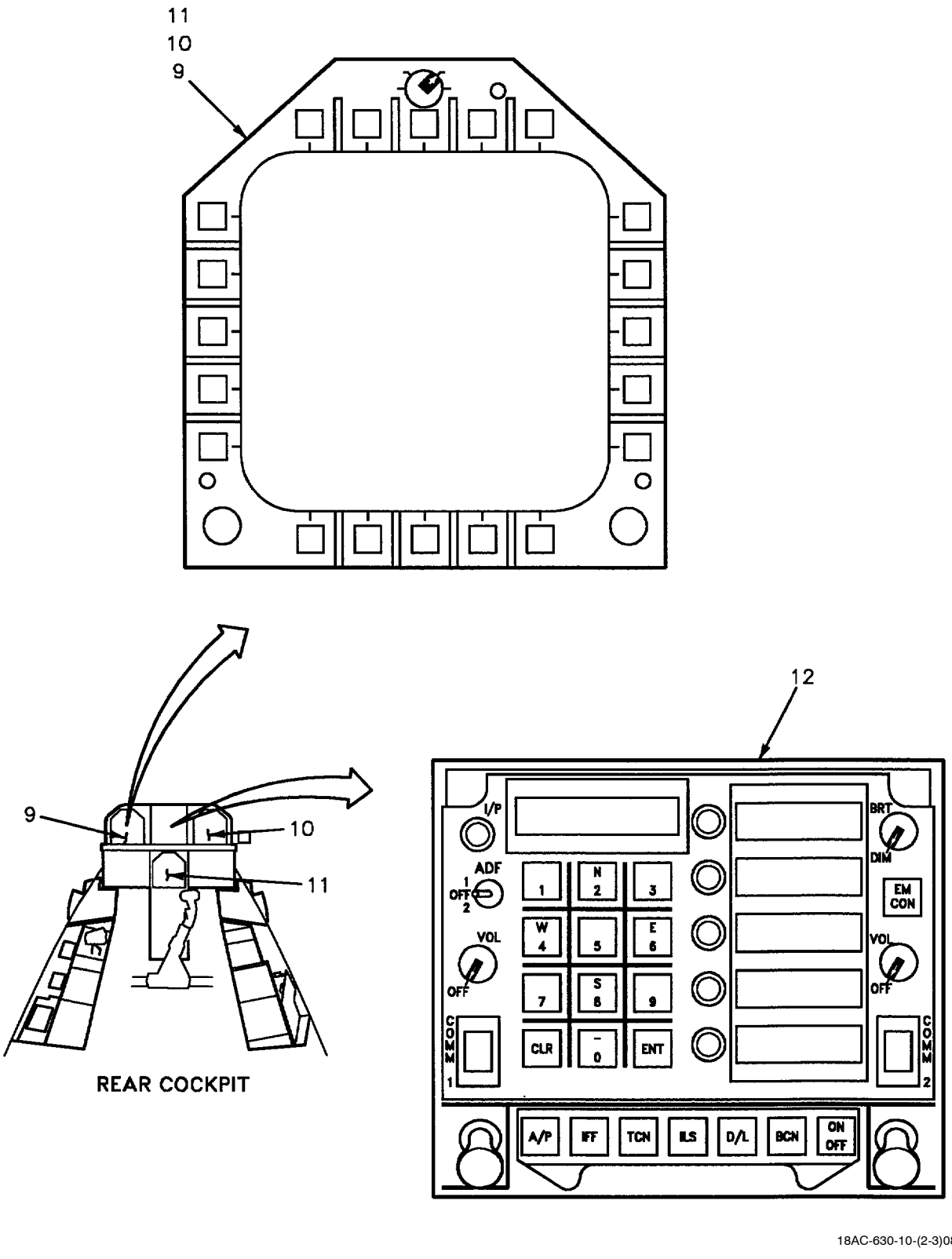
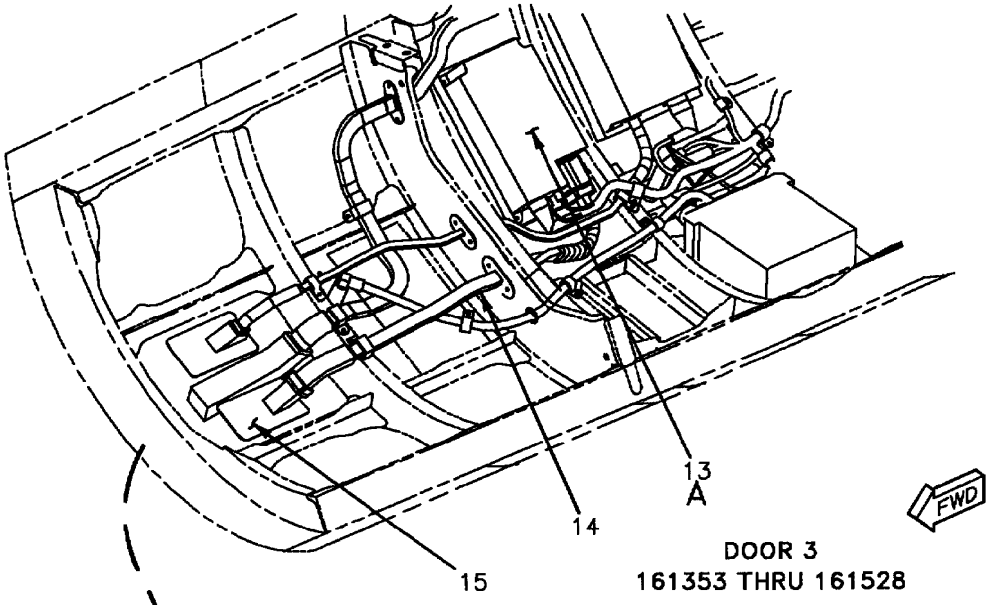
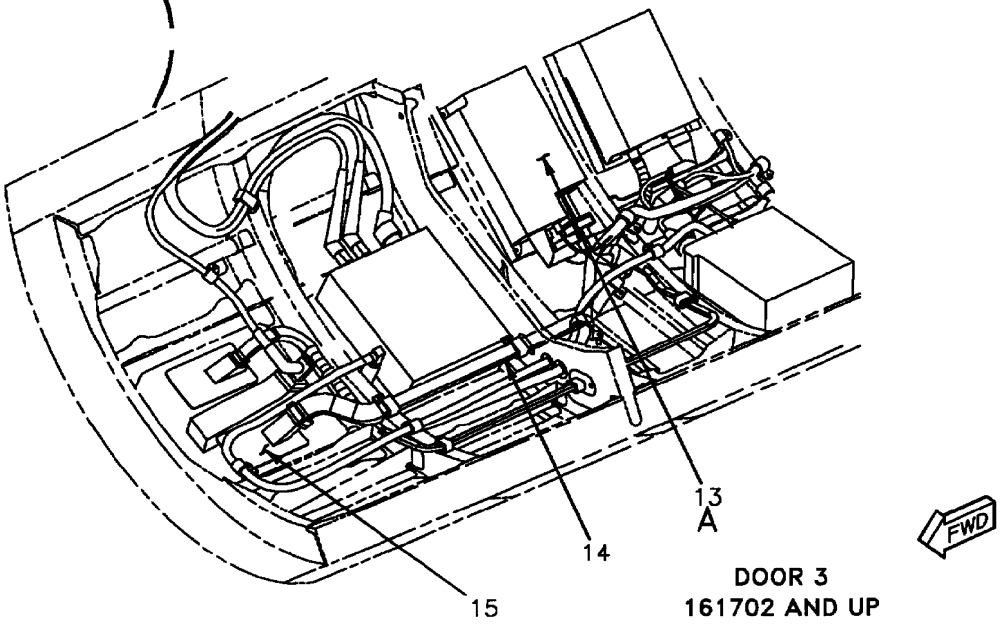
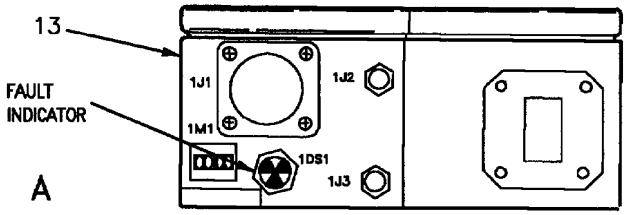


Figure 1. ILS Locator (Sheet 3)







18AC-630-1-(2-4)08-CATI

Figure 1. ILS Locator (Sheet 4)

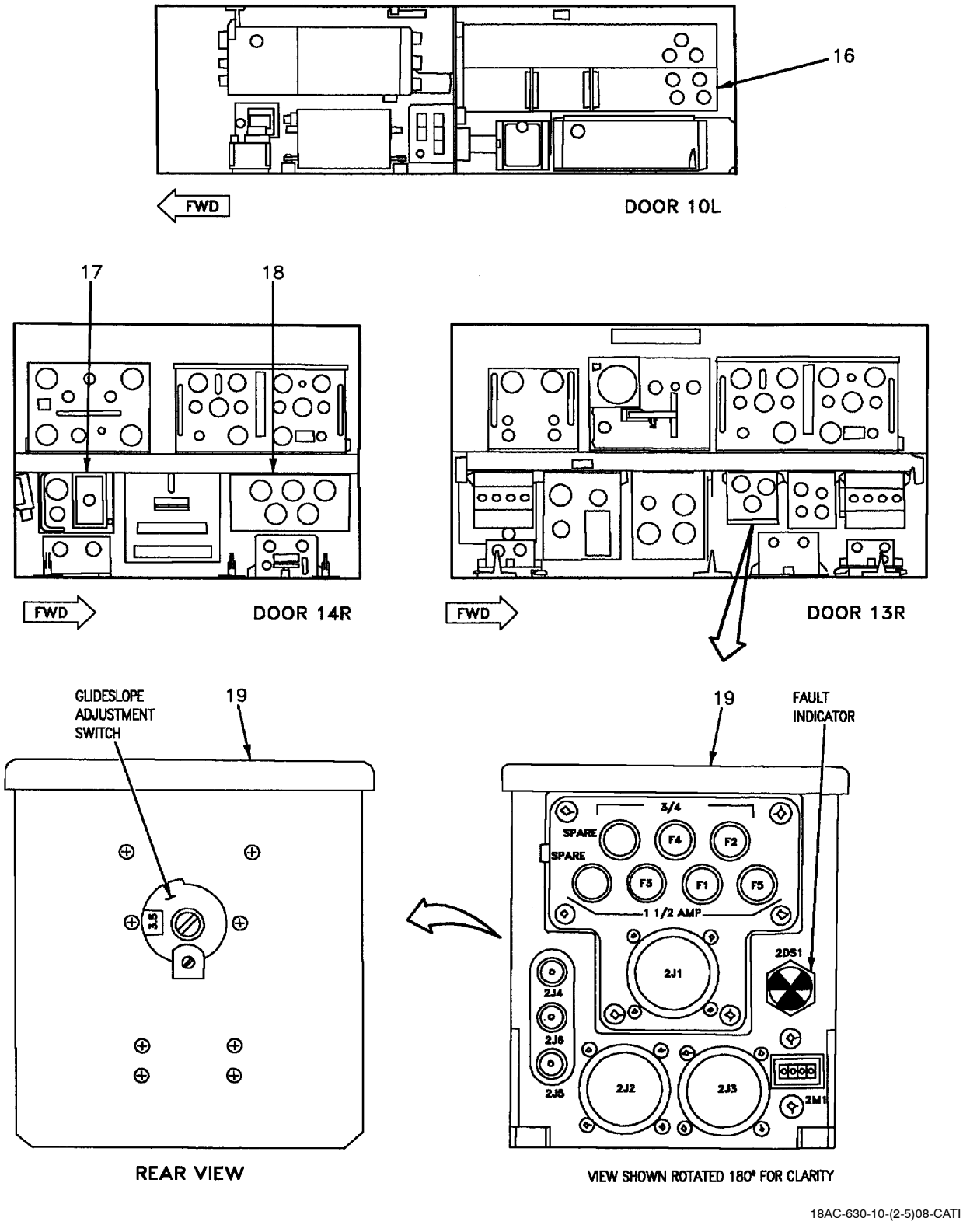


Figure 1. ILS Locator (Sheet 5)

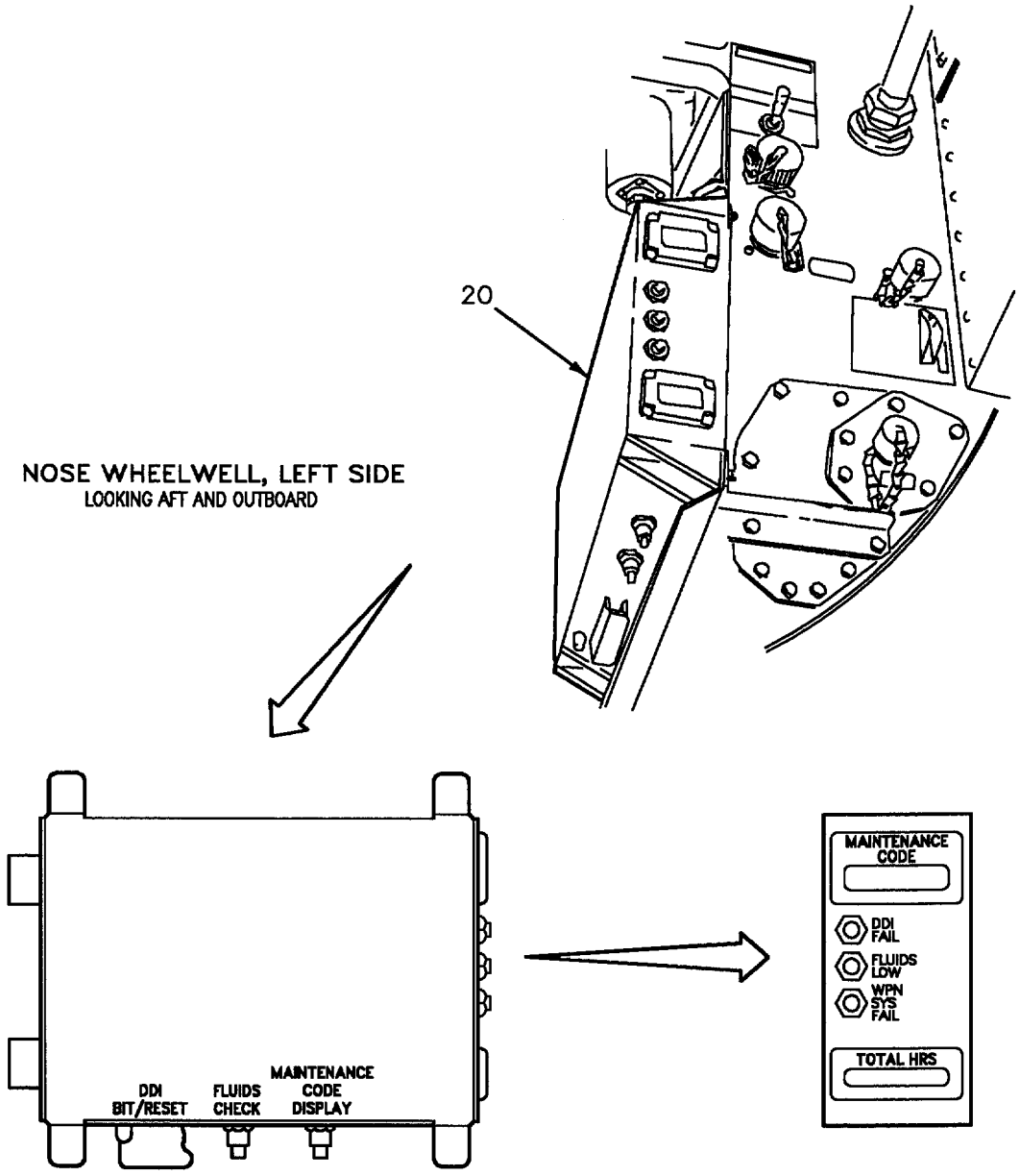


Figure 1. ILS Locator (Sheet 6)

NOMENCLATURE	INDEX NO.	REF DES
ATTITUDE REFERENCE INDICATOR	7	33M-J015
DIGITAL DISPLAY INDICATOR	20	85A-G003
ELECTRONIC EQUIPMENT CONTROL	6	79A-J006
GROUND POWER CONTROL PANEL ASSEMBLY	1	1A-H004
HEAD-UP DISPLAY UNIT	5	79A-J001
HORIZONTAL INDICATOR	8	80A-J003
INTERCOMMUNICATION AMPLIFIER-CONTROL	4	76A-H009
KU-BAND ANTENNA	15	74E-A011
KU-BAND WAVEGUIDE ASSEMBLY	14	74W-B501
LEFT DIGITAL DISPLAY INDICATOR	2	80A-H001
NO. 2 RELAY PANEL ASSEMBLY	18	52A-F058
ILS CONTROL RELAY NO. 1		74K-F009
ILS CONTROL RELAY NO. 2		74K-F010
NO. 7 CIRCUIT BREAKER/RELAY PANEL ASSEMBLY	16	52A-C057
ILS (A7)		74CBC006
ILS (A15)		74CBC003
ILS (B15)		74CBC004
ILS (C15)		74CBC005
PULSE DECODER	19	74A-F002
RADIO RECEIVER	13	74REB001
REAR CENTER DIGITAL DISPLAY INDICATOR	11	80A-L016
REAR ELECTRONIC EQUIPMENT CONTROL	12	76A-L028
REAR LEFT DIGITAL DISPLAY INDICATOR	9	80A-K019
REAR RIGHT DIGITAL DISPLAY INDICATOR	10	80A-L017

Figure 1. ILS Locator (Sheet 7)

NOMENCLATURE	INDEX NO.	REF DES
RIGHT DIGITAL DISPLAY INDICATOR	3	80A-J002
SIGNAL DATA RECORDER	17	85A-F001

Figure 1. ILS Locator (Sheet 8)

ORGANIZATIONAL MAINTENANCE

PRINCIPLES OF OPERATION

OPERATION - SEQUENCE OF

INSTRUMENT LANDING SYSTEM

This WP supersedes WP005 00, dated 1 November 1990.

Reference Material

Alphabetical Index

Record of Applicable Technical Directives

None

1. INTRODUCTION.

2. Instrument Landing System (ILS) operation is divided into sequence of operation and functional operation. Sequence of operation is contained in this WP. If functional operation is required, refer to WP006 00.

3. SEQUENCE OF OPERATION.

4. The ILS is an all weather approach guidance system. The ILS provides steering information during an aircraft approach to the Head-Up Display Unit and the Attitude Reference Indicator. On aircraft WITH DIGITAL DATA COMPUTER CONFIG/IDENT 89A AND UP, steering information can also be displayed on the electronic ADI display.

5. Discussion of the ILS sequence of operation is divided into the headings listed below:

a. primary mode

b. backup mode

c. ACL mode

d. built-in test mode

For locator, refer to WP004 00.

6. **PRIMARY MODE.** Refer to figure 1. To turn the ILS on, press the ILS function select switch then the ON/OFF switch on the electronic equipment control (equipment control). ON is then displayed on the scratch pad display along with the last ILS channel used. In the primary mode of operation, the equipment control controls the ILS. This is done when the ILS UFC/MAN switch on the intercommunication amplifier-control (amplifier-control) is set to UFC.

7. CHNL is the display on the first option display. A colon appears next to CHNL, indicating that the last ILS channel used has automatically been selected and displayed on the scratch pad display. New ILS channels are entered on the keyboard. There are 20 channels available to the ILS. If a channel higher than 20 is entered on the keyboard, the scratch pad displays error.

8. ILS steering is displayed on the HUD by pressing the ILS pushbutton switch on HSI display. Normally the HSI display is on the horizontal indicator but can also be displayed on the left or right digital display indicator by pressing the HSI pushbutton switch on the MENU display.

9. ILS steering on the HUD is referenced to the velocity vector. The elevation deviation bar indicates an ILS approach above or below the glide slope. The azimuth deviation bar indicates an ILS approach left or right of the glidepath. When the deviation bars are centered through the velocity vector, the aircraft is on the correct approach.

10. ILS steering is automatically displayed on the ARI with the ILS turned on. ILS steering on the ARI is referenced to the miniature airplane. The horizontal needle indicates an ILS approach above or below the glide slope. An alternative electronic attitude display indicator (ADI) is available by selecting ADI on the MENU display.

11. The vertical needle indicates an ILS approach left or right of the glidepath. The aircraft is on the correct approach when the steering needles are centered through the miniature airplane. On F/A-18B, the rear ARI provides pitch and roll information only. No ILS steering information is displayed. To turn off the ILS, press the ILS function select switch then the ON/OFF switch on the UFC.

12. **BACKUP MODE.** Refer to figure 2. To turn the ILS on, set the ILS UFC/MAN switch to MAN. If the ILS function select switch is pressed on the equipment control, MAN appears on the option display. This indicates that the ILS is being operated manually in the backup mode. In the backup mode of operation, the amplifier-control controls the ILS.

13. ILS channels are selected by the ILS CHANNEL select switches on the amplifier-control. There are 20 channels available. ILS steering is automatically displayed on the ARI when the ILS is turned on.

14. ILS steering can also be displayed on the HUD. This is done by pressing the ILS pushbutton switch on HSI display. Normally the HSI display is on the horizontal indicator but can be displayed on the left or right digital display indicator by pressing the HSI pushbutton switch on the MENU display. An alternative electronic attitude display indicator (ADI) is available by selecting ADI on the MENU display.

15. To turn off the ILS, set the ILS UFC/MAN switch on the amplifier-control to UFC. If the ILS function select switch on the UFC is selected, MAN disappears from the option display when the ILS is turned off.

16. **ACL MODE.** The mission computer system controls the ILS when the data link system is operating in the ACL mode. When operating the aircraft in the navigation master mode, the ILS is turned on by selecting ACL on a HSI display. Normally the HSI display is on the horizontal indicator but can be displayed on the left or right digital display indicator by pressing the HSI pushbutton switch on the MENU display.

17. When the mission computer system turns the ILS on, it also provides an ILS steering display on the HUD. ILS steering can also be displayed on the left or right digital display indicator by pressing the

HUD pushbutton switch on the MENU display. An alternative electronic attitude display indicator (ADI) is available by selecting ADI on the MENU display. The ILS channel used in ACL is the last channel that was selected using the UFC.

18. **BUILT-IN TEST.** Initiated BIT of the ILS is done manually. However, the ILS UFC/MAN switch on the amplifier-control must be set to UFC before initiated BIT can be done. No BIT can be done in the backup mode of operation.

19. **Manually Initiated BIT.** Refer to figure 3. When the ILS is operating in the primary mode, BIT is manually started using the left or right digital display indicator. To manually start BIT, press the ILS/AUG/BCN/D/L pushbutton switch on the BIT control display. IN TEST is displayed for 15 seconds after BIT is initiated. During BIT, an ILS BIT steering display is shown on the HUD and ARI (figure 4). After 15 seconds, the ILS BIT status is GO if BIT passes and DEGD if BIT fails. If BIT is started when the ILS is off, NOT RDY is displayed. NOT RDY is also displayed if BIT is not completed in 15 seconds. NOT RDY is displayed for 65 seconds, then RESTRT.

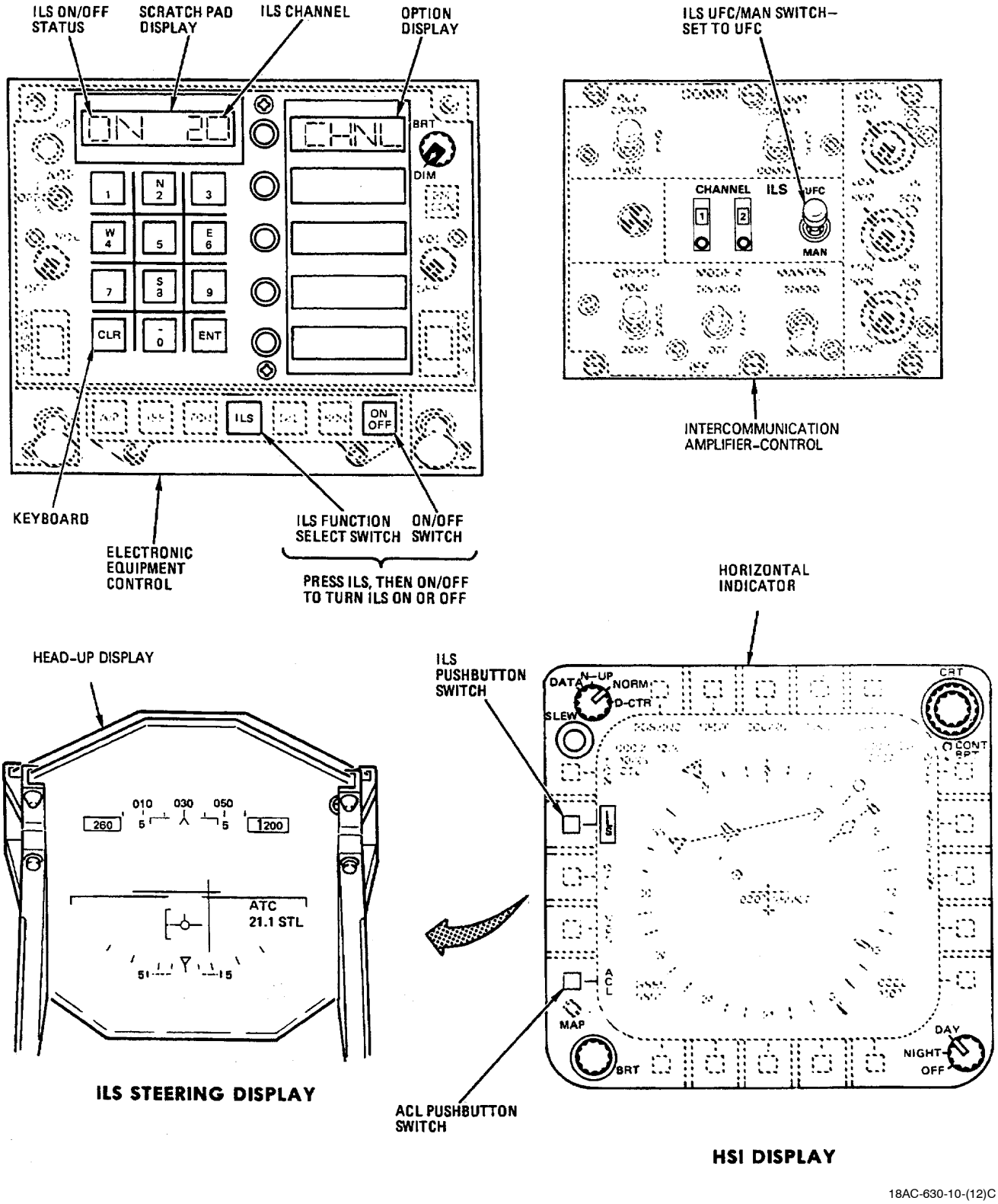
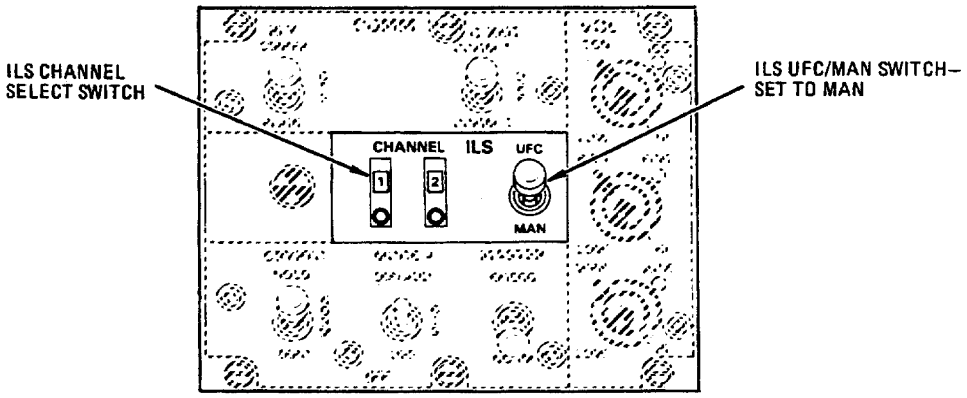
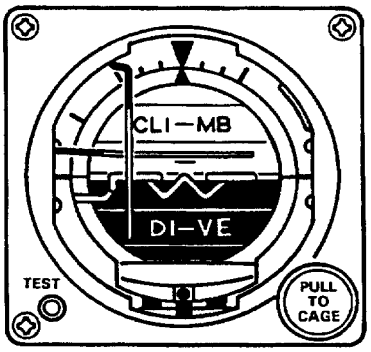


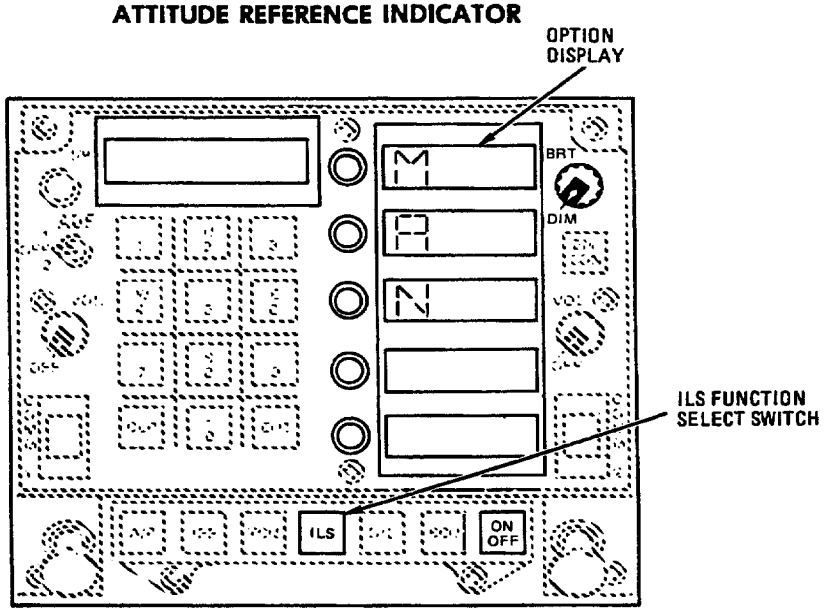
Figure 1. Primary Mode



INTERCOMMUNICATION AMPLIFIER-CONTROL



ATTITUDE REFERENCE INDICATOR



ELECTRONIC EQUIPMENT CONTROL

18AC-630-10-(11)A

Figure 2. Backup Mode

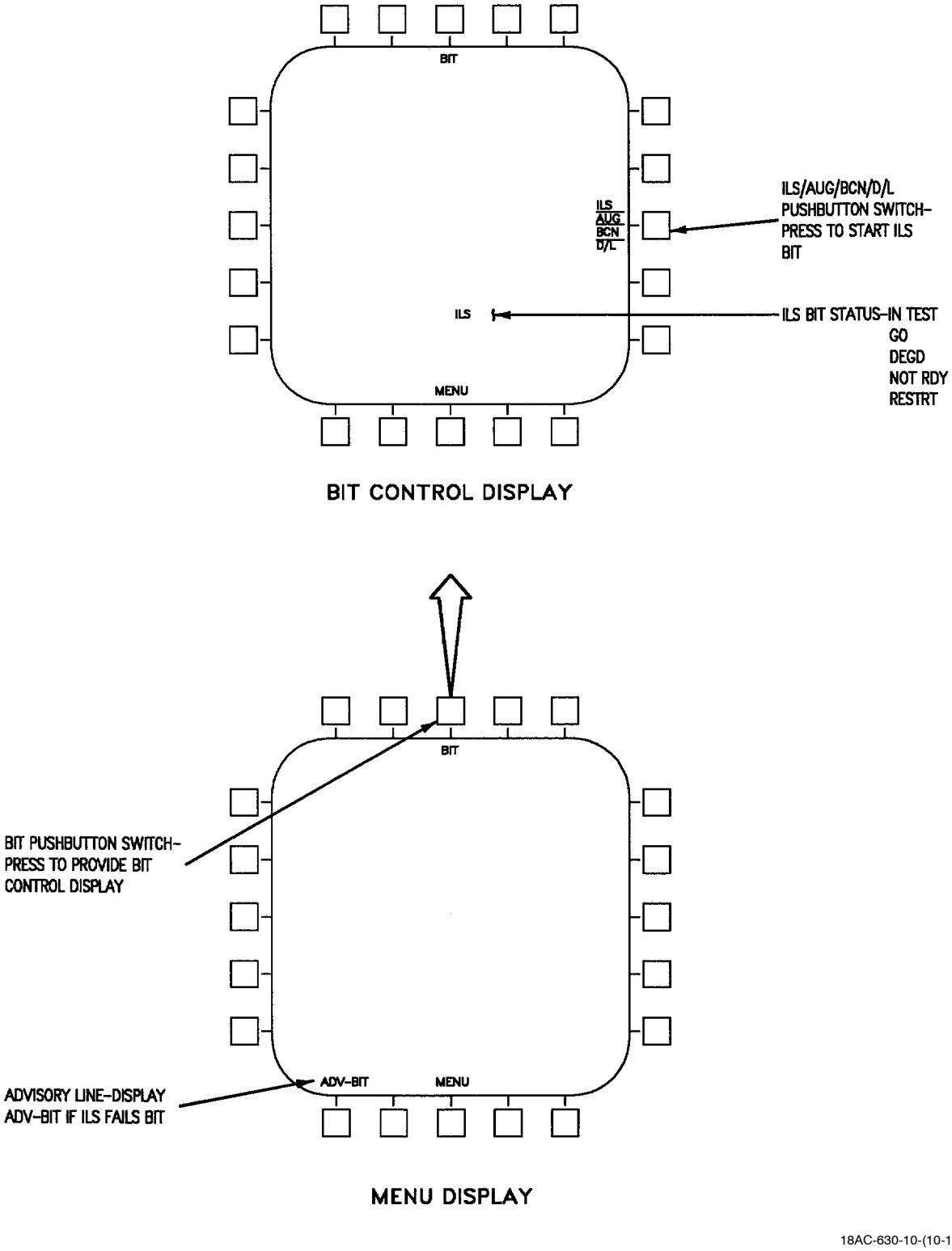
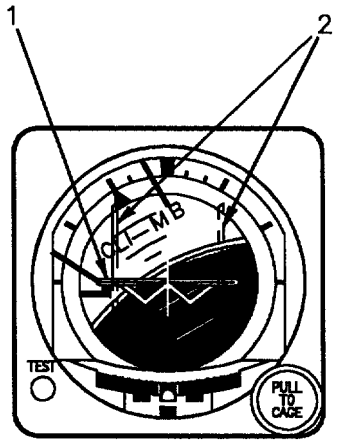
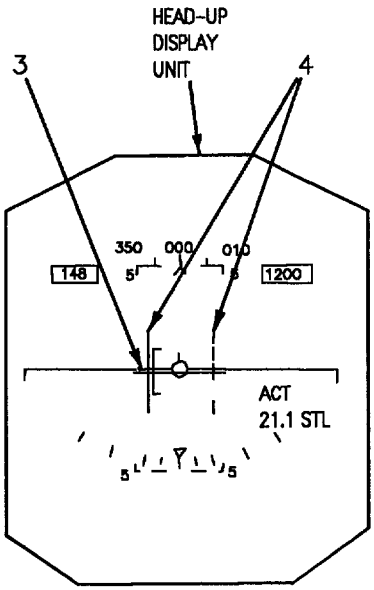


Figure 3. Manually Initiated BIT



ATTITUDE REFERENCE INDICATOR



ILS STEERING DISPLAY

INDEX NO.	NOMENCLATURE	ILS BIT INDICATIONS
1	HORIZONTAL NEEDLE	ON THE GLIDE SLOPE
2	VERTICAL NEEDLE	OSCILLATING BETWEEN 1/3 SCALE FLY LEFT AND 1/3 SCALE FLY RIGHT
3	ELEVATION DEVIATION BAR	ON THE HORIZON
4	AZIMUTH DEVIATION BAR	OSCILLATING BETWEEN 1/3 SCALE FLY LEFT AND 1/3 SCALE FLY RIGHT

18AC-630-10-(9-1)08-CATI

Figure 4. ILS BIT Steering Displays

ORGANIZATIONAL MAINTENANCE

PRINCIPLES OF OPERATION

OPERATION - FUNCTIONAL

INSTRUMENT LANDING SYSTEM

This WP supersedes WP006 00, dated 1 November 1990.

Reference Material

Alphabetical Index

Record of Applicable Technical Directives

None

1. INTRODUCTION.

2. The Instrument Landing System (ILS) is an all weather aircraft approach guidance system. The ILS provides steering information during an aircraft approach by decoding transmitted azimuth and elevation microwave signals. The ILS displays the steering information on the head-up display unit (HUD) and the attitude reference indicator (ARI). On aircraft WITH DIGITAL DATA COMPUTER CONFIG/IDENT 89A AND UP, steering

information can also be displayed on the electronic ADI display.

3. Discussion of the ILS operation is divided as listed below:

a. power application

b. channel selection

c. steering displays

d. built-in test modes

Refer to Instrument Landing System Simplified Schematic, Figure 1, WP007 00. WP005 00 contains the sequence of operation for the ILS.

4. POWER APPLICATION.

5. When aircraft electrical power is applied, 28vdc is sent to the coil of no. 2 relay panel assembly ILS control relay no. 1 (74K-F009). This relay controls all power to the ILS. An ILS on/off (ground) signal is used to energize the relay.

6. With ILS control relay no. 1 energized, 28vdc is sent to the coil of relay K1 in the Pulse Decoder (decoder). Relay K1 is then energized and 115vac is sent to the decoder power supply. The decoder power supply provides power for the decoder and the Radio Receiver (receiver).

7. The 28vdc sent to decoder relay K1 is also routed through ILS control relay no. 2 to the receiver. The 28vdc is used to energize the receiver shutter switch. When energized, the shutter switch is open, allowing ILS signals to be received.

8. The ILS on/off (ground) signal, used to energize ILS control relay no. 1, exists during three ILS modes of operation:

a. primary mode

b. backup mode

c. ACL mode

9. **PRIMARY MODE.** Power to the ILS is controlled by the electronic equipment control (equipment control) during the primary mode of operation. This is done when the ILS UFC/MAN switch on the intercommunication amplifier-control (amplifier control) is set to UFC and GND PWR control panel assembly 2 switch is set to A or B ON.

10. When the ILS function select switch and the ON/OFF switch is pressed on the equipment control, the control-converter produces an ILS on/off command (ground). This ground signal is used to energize ILS control relay no. 1. With the ILS turned on, the equipment control displays ON in the scratch pad display.

11. The ILS is turned off by pressing the ILS function select switch and the ON/OFF switch on the equipment control. This removes the ILS on/off ground signal from the coil of ILS control relay no. 1, turning off the ILS. With the ILS off, ON disappears from the equipment control scratch pad display.

12. **BACKUP MODE.** In the backup mode of operation, power to the ILS is controlled by the amplifier control. This is done by setting the ILS UFC/MAN switch to MAN. If the ILS function select switch is pressed, MAN is displayed on the option display. This indicates that the ILS is in the backup mode. In the backup mode, an ILS on/off (ground) signal is sent from the amplifier control to ILS control relay no. 1. The relay is then energized and power is sent to the ILS.

13. The ILS is turned off by setting the ILS UFC/MAN switch to UFC. The ground is removed from the coil of ILS control relay no. 1 and power is removed from the ILS.

14. **ACL MODE.** Power to the ILS is controlled by the digital data computer No. 1 (digital computer) when the data link system is operating in the ACL mode. However, the ILS UFC/MAN switch must be set to UFC. The digital computer produces a digital ILS on message when the aircraft is operating in the navigation master mode and ACL is selected on a HSI display. The digital message commands the control-converter to produce an ILS on/off command (ground).

15. The ground signal from the control-converter energizes ILS control relay no. 1, turning the ILS on. The ILS is controlled by the digital computer as long as ACL is still selected on the HSI display. If the ILS function select switch is pressed, ON is displayed on the equipment control scratch pad display. This indicates that the ILS has been turned on by the digital computer.

16. The ILS is turned off when ACL is deselected on the HSI display. The digital computer then tells the control-converter to remove the ILS on/off

ground signal from the coil of ILS control relay no. 1, turning off the ILS. With the ILS turned off, ON disappears from the equipment control scratch pad display.

17. CHANNEL SELECTION.

18. The ILS operates on 20 channels using 10 frequencies. Channels are selected and sent to the local oscillator of the receiver for processing. Channels 11 to 20 use the same coinciding frequencies as channels 1 to 10. The difference is that the pulse spacing of the ILS signals is increased by one μsec for channels 11 to 20. The decoder determines the pulse spacing by using the channel order select signal.

19. If the channel order select signal is 5vdc, the decoder operates in channel range 1 to 10. If the channel order select signal is at ground potential, the decoder operates in the channel range 11 to 20. If the ILS signals being received do not match the channel selected, it is rejected by the decoder.

20. ILS channels are selected during three modes of operation:

a. primary mode

b. backup mode

c. ACL mode

21. **PRIMARY MODE.** ILS channels are selected on the equipment control in the primary mode of operation. However, the ILS UFC/MAN switch on the amplifier-control must be set to UFC. The ILS channels are entered on the keyboard and sent to the control-converter. The control-converter stores the channel in memory and sends it to the local oscillator of the receiver.

22. The ILS channel stored in memory is displayed on the scratch pad display. If the channel entered on the keyboard is greater than 20, the scratch pad displays a flashing “Error”. New channels entered on the keyboard are displayed on the scratch pad display and replace the old channel stored in memory.

23. A channel order select signal is sent from the control-converter to the decoder. With channels 1 to 10 entered on the keyboard, the channel order select signal is 5vdc and the decoder operates in the channel range 1 to 10. With channels 11 to 20 entered, the channel order select signal is at ground potential and the decoder operates in the channel range 11 to 20.

24. **BACKUP MODE.** The amplifier control selects the ILS channels during the backup mode of operation. The ILS UFC/MAN switch is positioned to MAN in this mode. GND PWR control panel assembly 4 switch must be set to A or B ON. ILS channels are selected on the ILS CHANNEL thumbwheel switches and sent to the local oscillator of the receiver.

25. A channel order select signal is sent to the decoder from the amplifier-control. With channels 1 to 10 selected by the thumbwheel switches, the channel order select signal is 5vdc and the decoder operates in the channel range 1 to 10. With channels 11 to 20 selected, the channel order select signal is at ground potential and the decoder operates in the channel range 11 to 20.

26. **ACL MODE.** The ILS is controlled by the digital computer when the data link system is operating in the ACL mode. If the aircraft is operating in the navigation master mode and ACL is selected on a HSI display, the digital computer produces a digital ILS on message. The digital message commands the control-converter to turn on the ILS.

27. The ILS operates on the last channel stored in the control-converter memory. New ILS channels can then be entered on the keyboard. If the ILS function select switch is pressed, the channel stored in the control-converter memory is displayed on the scratch pad display.

28. STEERING DISPLAYS.

29. Refer to figure 1. ILS steering is displayed on the HUD and the ARI. An alternate electronic attitude display indicator (ADI) is also available. ILS steering is displayed during three ILS modes of operation:

a. primary mode

b. backup mode

c. ACL mode

30. **PRIMARY MODE.** Azimuth and elevation steering information produced by the decoder is sent to the control-converter. The control-converter

converts the steering signals into digital information and sends it to the digital computer. The control-converter also receives azimuth and elevation deviation flag signals from the decoder. If a flag signal does exist, the control-converter receives the steering information as valid data. The control-converter then sends an azimuth or elevation deviation valid signal to the digital computer.

31. If a flag signal does not exist, the control-converter receives the steering information as not valid data. The control-converter then removes the azimuth or elevation deviation valid signal from the digital computer and sends an azimuth or elevation deviation flag fail signal.

32. The digital computer uses the signals from the control-converter to provide an ILS steering display on the HUD. To produce the display, the conditions listed below must exist:

a. The azimuth deviation bar is not displayed unless azimuth deviation information is being received and is valid.

b. The elevation deviation bar is not displayed unless elevation deviation information is being received and is valid.

c. The ILS pushbutton switch must be selected on a HSI display.

33. An electronic attitude display indicator (ADI) is available on the left or right displays as an alternative to the attitude display on the HUD. The ADI display is selected by selecting the ADI option on the menu. Airspeed and altitude are displayed in the upper corners. In the NAV master mode, the air data computer altitude rate is displayed above the altitude and the ILS steering needles are displayed when ILS steering is selected on the HSI display and ILS steering signals are valid.

34. ILS steering is automatically displayed on the ARI when the ILS is turned on. A ground is sent to the ARI from no. 2 relay panel assembly ILS control relay no. 1 (74K-F009) enabling the needles to be driven by the decoder.

35. Steering information from the decoder is sent directly to the needles of the ARI. If ILS signals are not being received, the decoder drives the ARI needles out of view. On F/A-18B aircraft, the rear ARI provides pitch and roll information only. No ILS steering information is displayed.

36. **BACKUP MODE.** In the backup mode, ILS steering information is provided on the ARI. When the ILS is turned on, a ground signal is applied to the ARI. This ground signal allows ILS steering signals to drive the steering needles on the ARI.

37. ILS steering information from the decoder is sent directly to the needles of the ARI. If ILS signals are not being received, the decoder drives the ARI needles out of view. ILS steering can also be displayed on the HUD in this mode. On F/A-18B aircraft, the rear ARI provides pitch and roll information only. No ILS steering information is displayed. Refer to primary mode, paragraph 30.

38. **ACL MODE.** When the data link system is operating in the ACL mode, ILS steering is automatically displayed on the HUD. This occurs when the aircraft is operating in the navigation master mode and ACL is selected on a HSI display. No ILS steering is displayed if azimuth or elevation deviation is not being received or the azimuth elevation deviation signals are not valid. The digital computer receives these signals the same way as in the primary mode.

39. BUILT-IN TEST.

40. The ILS built-in test (BIT) has two functions. It operates as a circuit operation monitor and starts self testing of ILS circuits (initiated BIT). The BIT circuit monitor function operates any time power is applied to the ILS. Initiated BIT is done manually in the primary mode. No BIT is done in the backup mode.

41. **BIT CIRCUIT MONITOR FUNCTION.** The decoder provides azimuth and elevation flag signals to the control-converter when ILS operation is not valid. If only one of the these signals exists, the control-converter sends an ILS WRA fail signal to the digital computer. This signal is sent by the digital computer to the Signal Data Recorder R0-508/ASM-612 (recorder).

42. The recorder converts the ILS WRA fail signal to a digital failure code and applies it to the digital display indicator. The digital display indicator stores the failure code for the ILS (148) in memory and displays the code on a digital display. The control-converter also causes the digital computer to produce an ILS WRA fail if the control-converter detects one of the signals listed below:

a. CSC Fail ILS on/off - produced if control-converter does not detect that the ILS has been turned on when requested.

b. CSC Fail ILS Channel - produced if the ILS channel selected is not sent to the ILS.

c. CSC Fail ILS Azimuth/Elevation - produced when ILS azimuth or elevation output does not exist when the ILS is on.

43. If an ILS WRA fail exists, the digital computer sends an advisory message (ADV-BIT) to the left digital display indicator. The advisory message appears on the advisory line of the left digital display indicator.

44. If azimuth or elevation steering is not valid, the decoder applies a deflecting voltage to the ARI needle, driving it out of view. Flag signals applied to the control-converter are sent to the digital computer. When the digital computer receives one of these signals, the appropriate deviation bar is removed from the HUD display.

45. A fault indicator is mounted on the receiver and decoder. If a unit fails, the fault indicator latches to an all white circle. Normally, it is black and white. A failure in the receiver causes the fault indicators on the receiver and decoder to latch. A failure in the decoder causes only the fault indicator on the decoder to latch.

46. The receiver BIT circuit monitors IF amplifier output. If no output exists, the receiver fault indicator is latched. This also causes the decoder fault indicator to latch. The receiver BIT circuitry also tests the mixer crystal voltage. Failure of the mixer crystal voltage inhibits IF amplifier output. This causes the receiver and decoder fault indicators to latch.

47. The decoder BIT circuit monitors the azimuth and elevation deviation outputs. If no signal exists, the decoder fault indicator is latched. The decoder BIT circuit also detects a power supply failure.

48. **MANUALLY INITIATED BIT.** With the ILS on, BIT is manually started from the left or right digital display indicator. This is done by pressing the ILS/AUG/BCN D/L pushbutton switch on the BIT control display. When pressed, a digital message is sent to the control-converter.

49. The control-converter uses the ILS initiated BIT request to produce a BIT on (ground) signal. This signal energizes ILS control relay no. 2 (74K-F010) in the no. 2 relay panel assembly. When energized, a ground is sent to the BIT circuitry of the receiver and decoder. The ground starts ILS BIT.

50. With the ILS BIT circuitry activated, the ILS produces BIT steering signals. BIT steering signals simulate ILS steering. BIT IF produced by the receiver is modulated by BIT modulation from the decoder. The receiver amplifies the IF video signal and sends it to the decoder for processing. The decoder processes the IF video as actual azimuth and elevation signals. These signals are displayed on the HUD and the ARI. Refer to Manually Initiated Bit, WP005 00.

51. The control-converter timing and monitor circuits provide ILS in test, ILS test complete, and ILS WRA fail signals to the digital computer. The digital computer uses these signals to compute BIT status messages for display on the BIT control display of the right digital display indicator. There are five BIT status messages - IN TEST, GO, DEGD, NOT RDY, and RESTRT.

52. IN TEST is displayed when the ILS BIT is started and the control-converter provides the ILS in test signal to the digital computer. GO is displayed when the ILS test complete signal is received from the control-converter and no ILS WRA fail exists. NOT RDY is displayed if BIT has been started on the ILS and the system has not been turned on or if the test is not complete in 15 seconds. NOT RDY is displayed for 65 seconds. After 65 seconds, RESTRT is displayed. DEGD is displayed if the control-converter sends the digital computer an ILS WRA fail signal when BIT is completed.

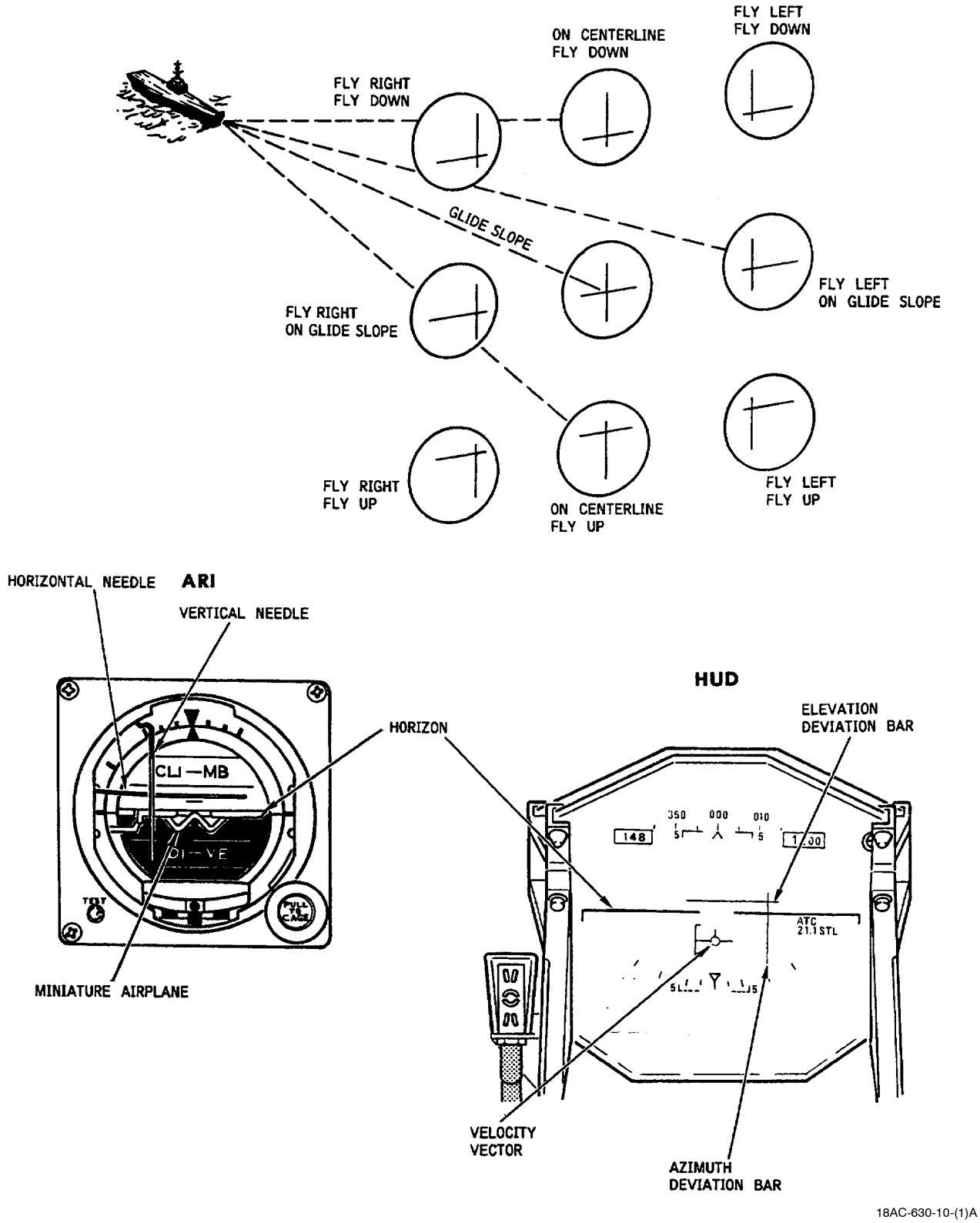


Figure 1. ILS Steering Displays

ORGANIZATIONAL MAINTENANCE

PRINCIPLES OF OPERATION

SCHEMATIC - SIMPLIFIED

INSTRUMENT LANDING SYSTEM

Reference Material

None

Alphabetical Index

Record of Applicable Technical Directives

None

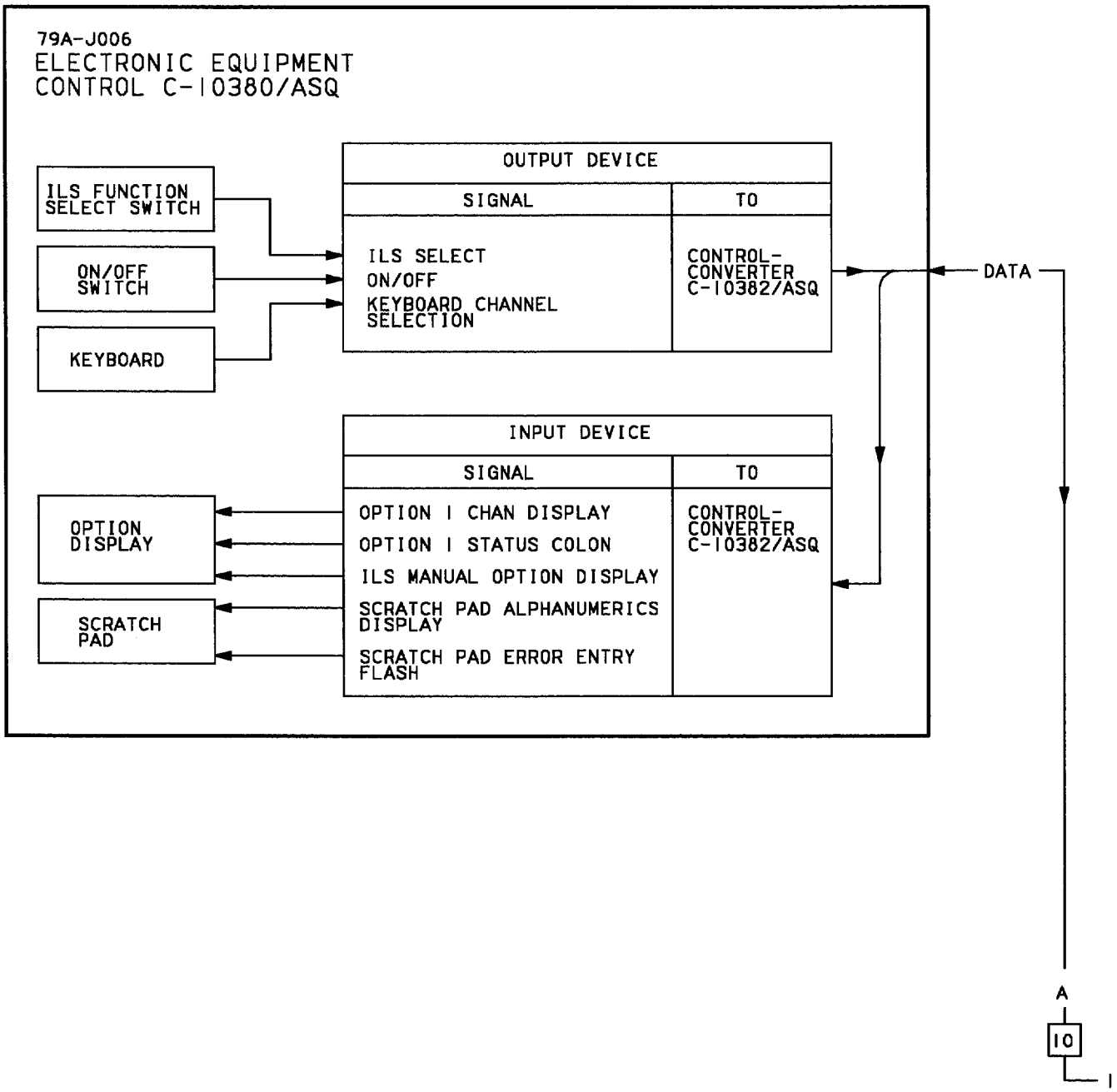


Figure 1. ILS Simplified Schematic (Sheet 1)

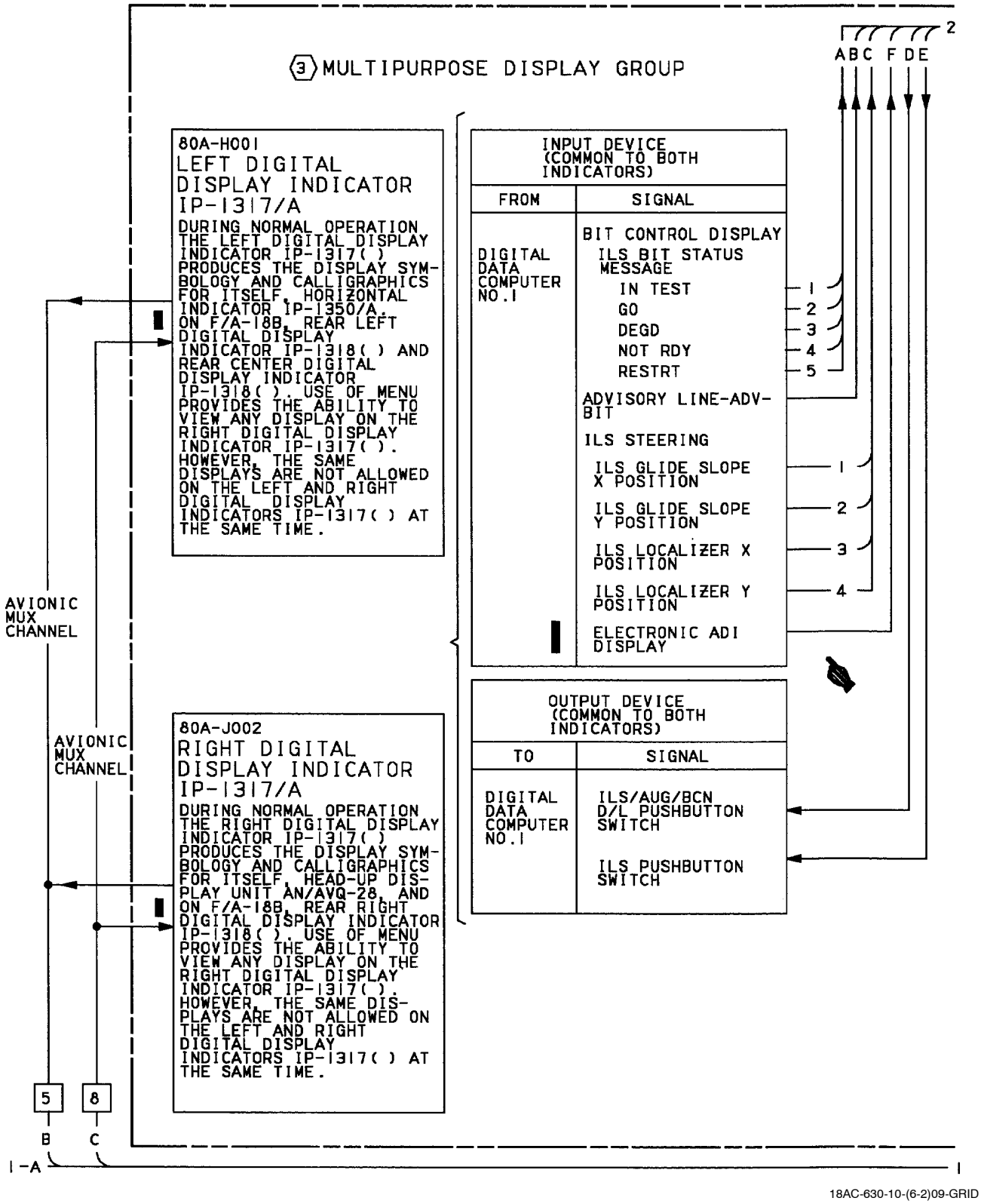


Figure 1. ILS Simplified Schematic (Sheet 2)

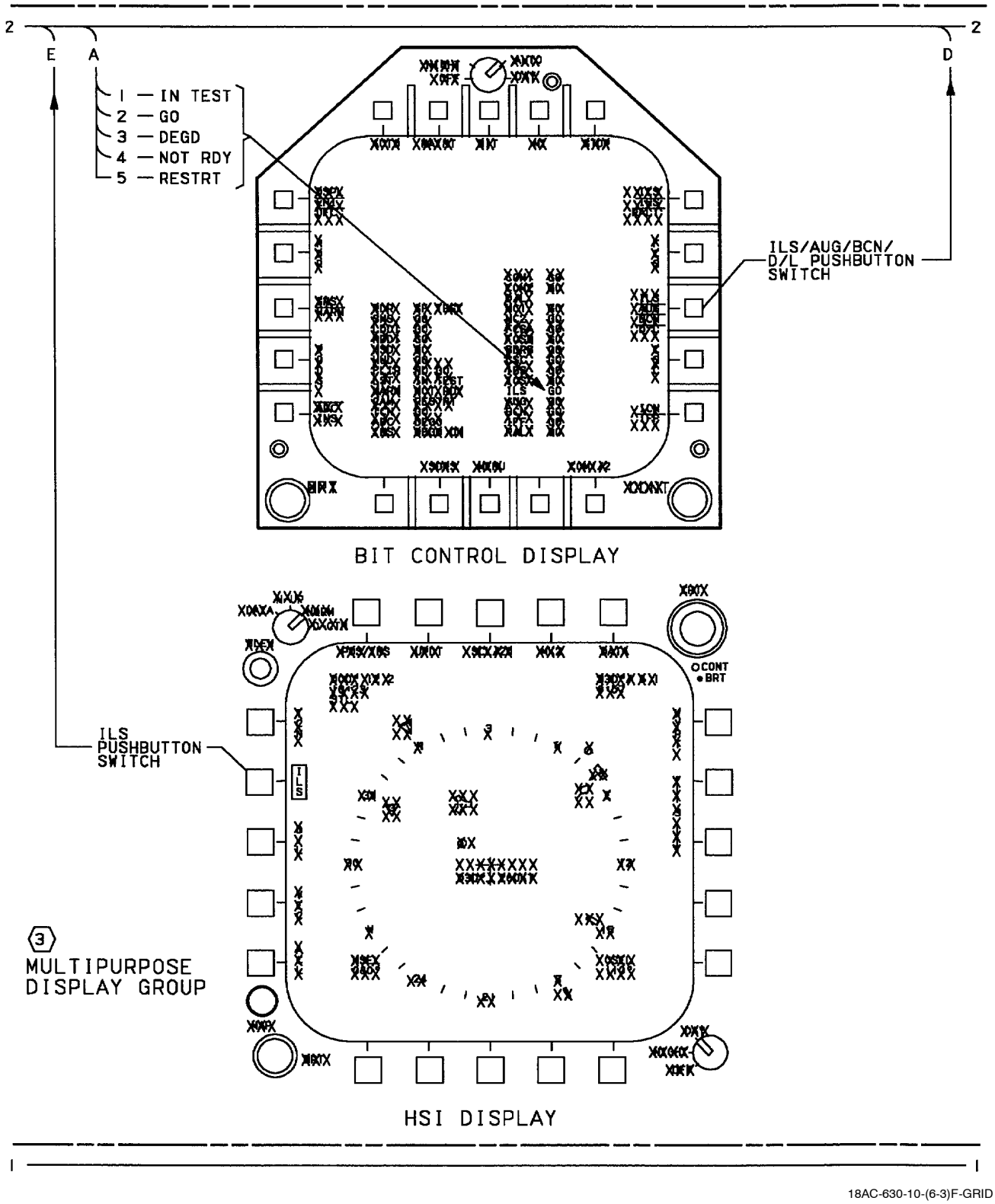


Figure 1. ILS Simplified Schematic (Sheet 3)

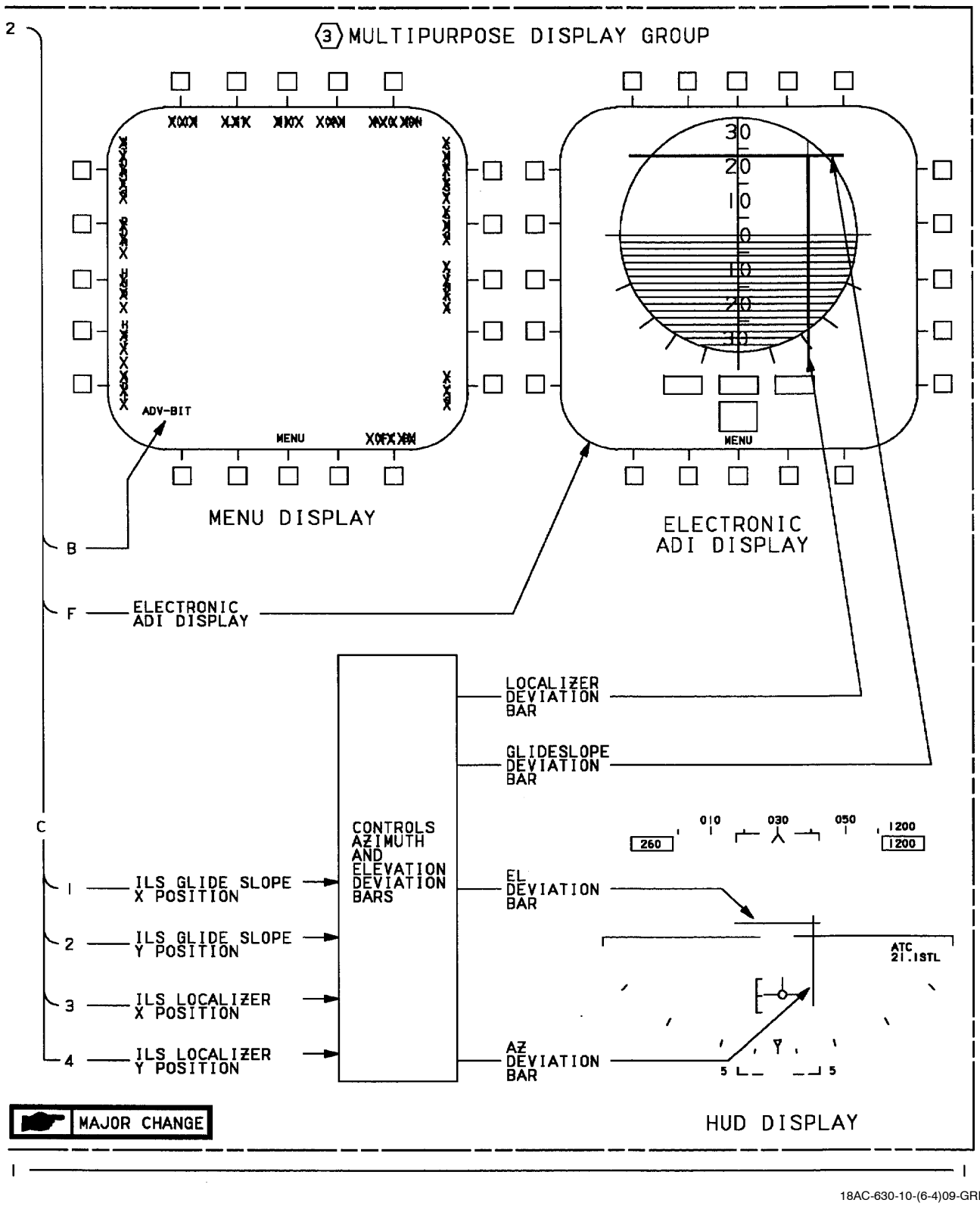


Figure 1. ILS Simplified Schematic (Sheet 4)

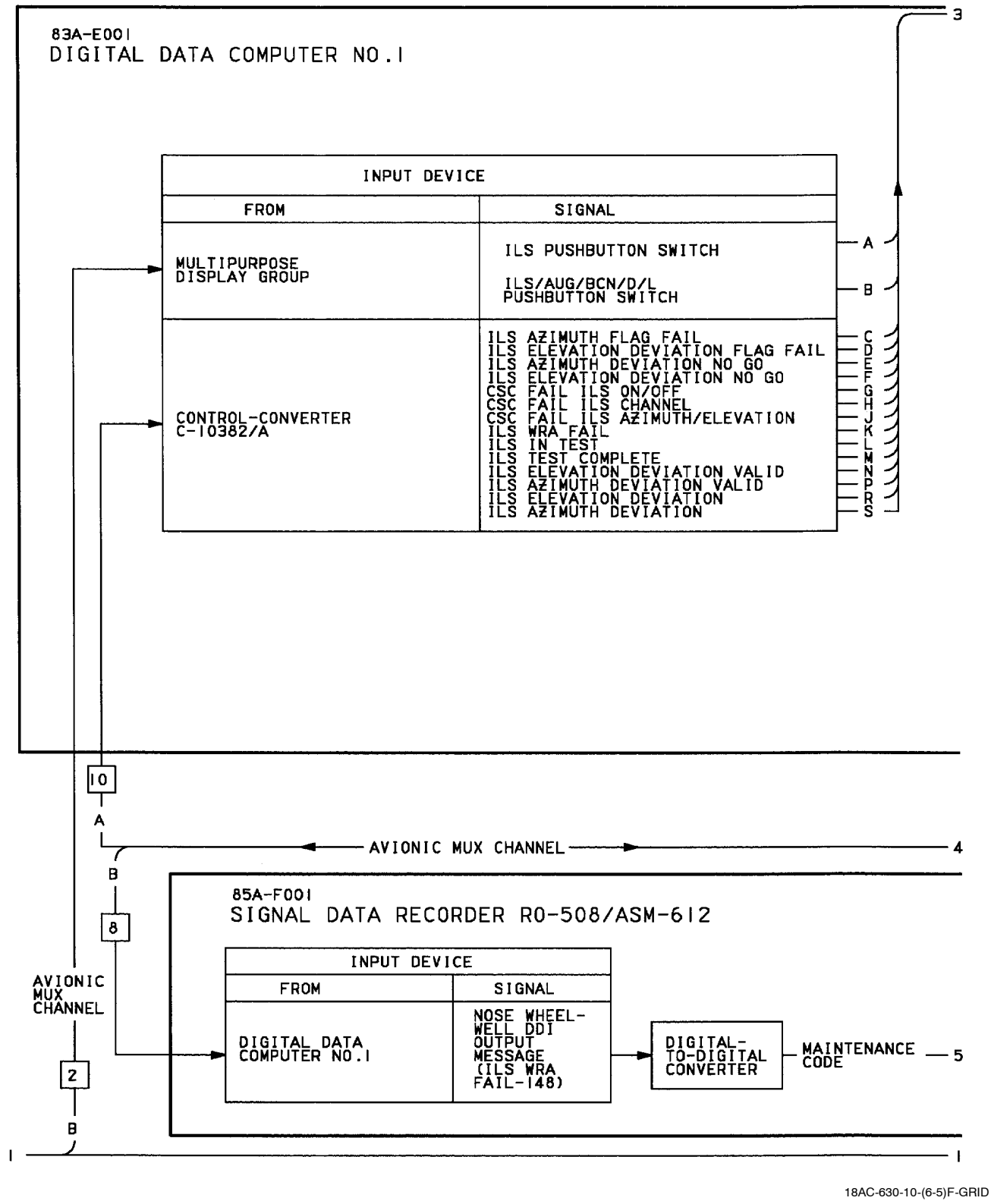


Figure 1. ILS Simplified Schematic (Sheet 5)

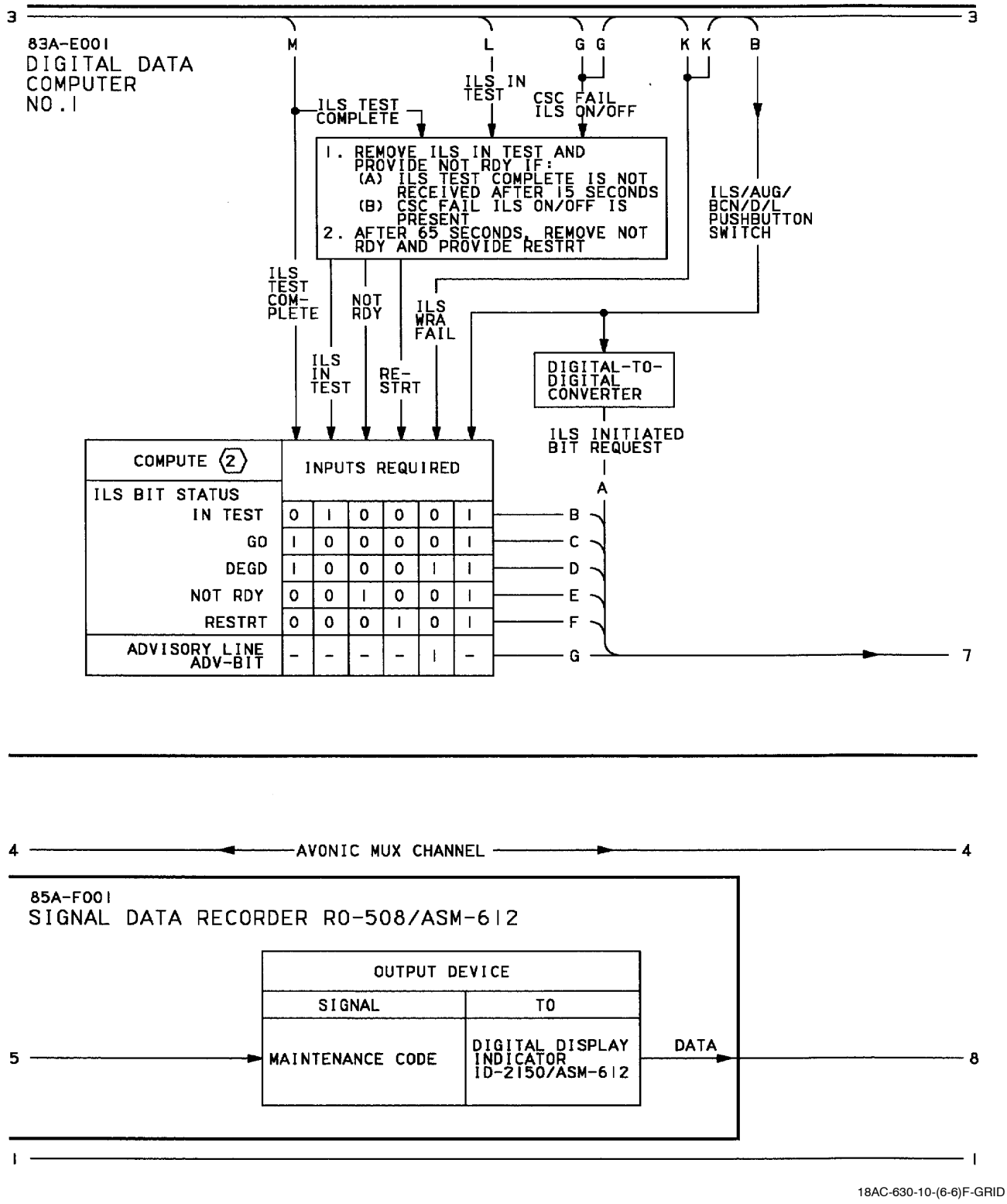


Figure 1. ILS Simplified Schematic (Sheet 6)

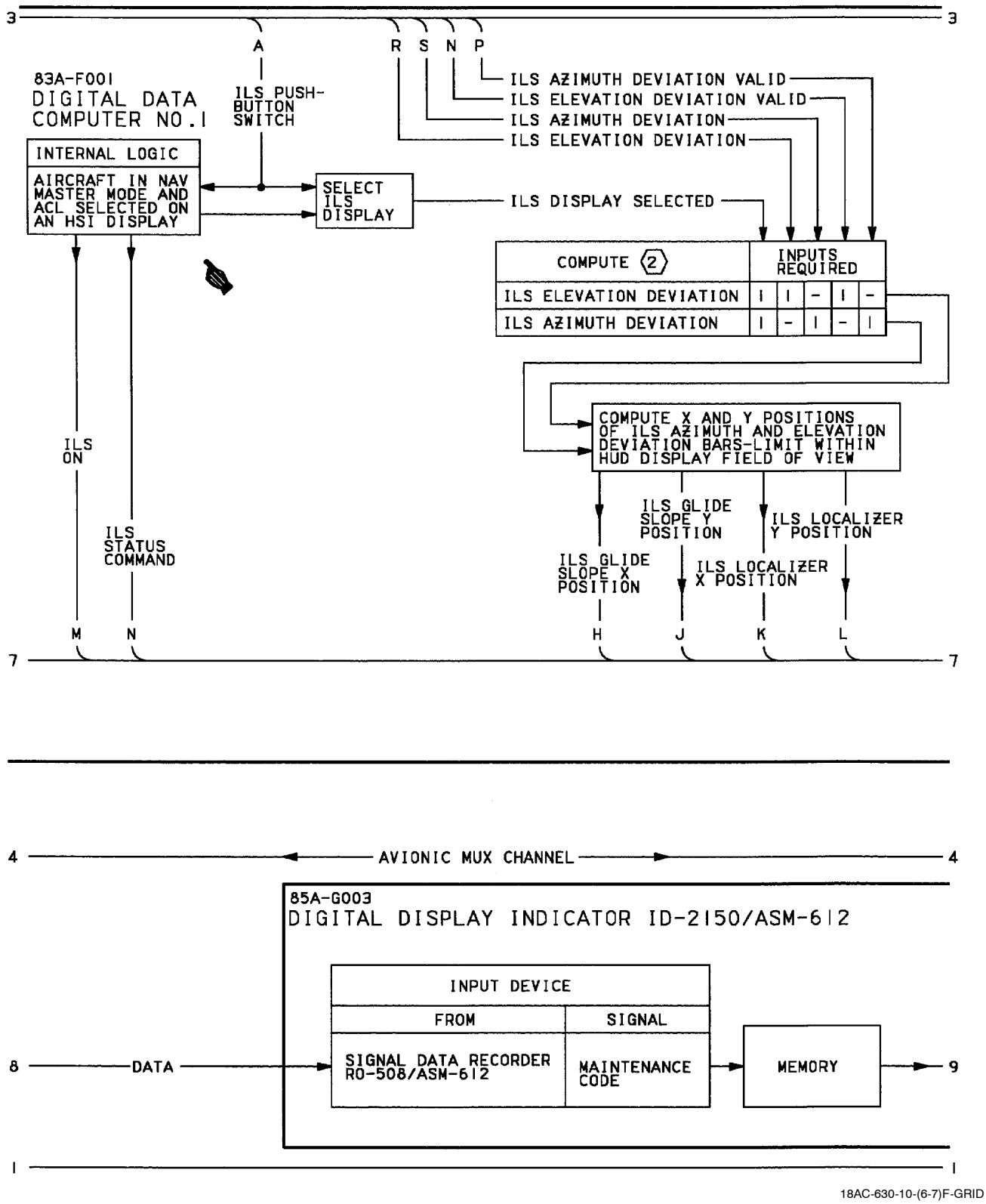
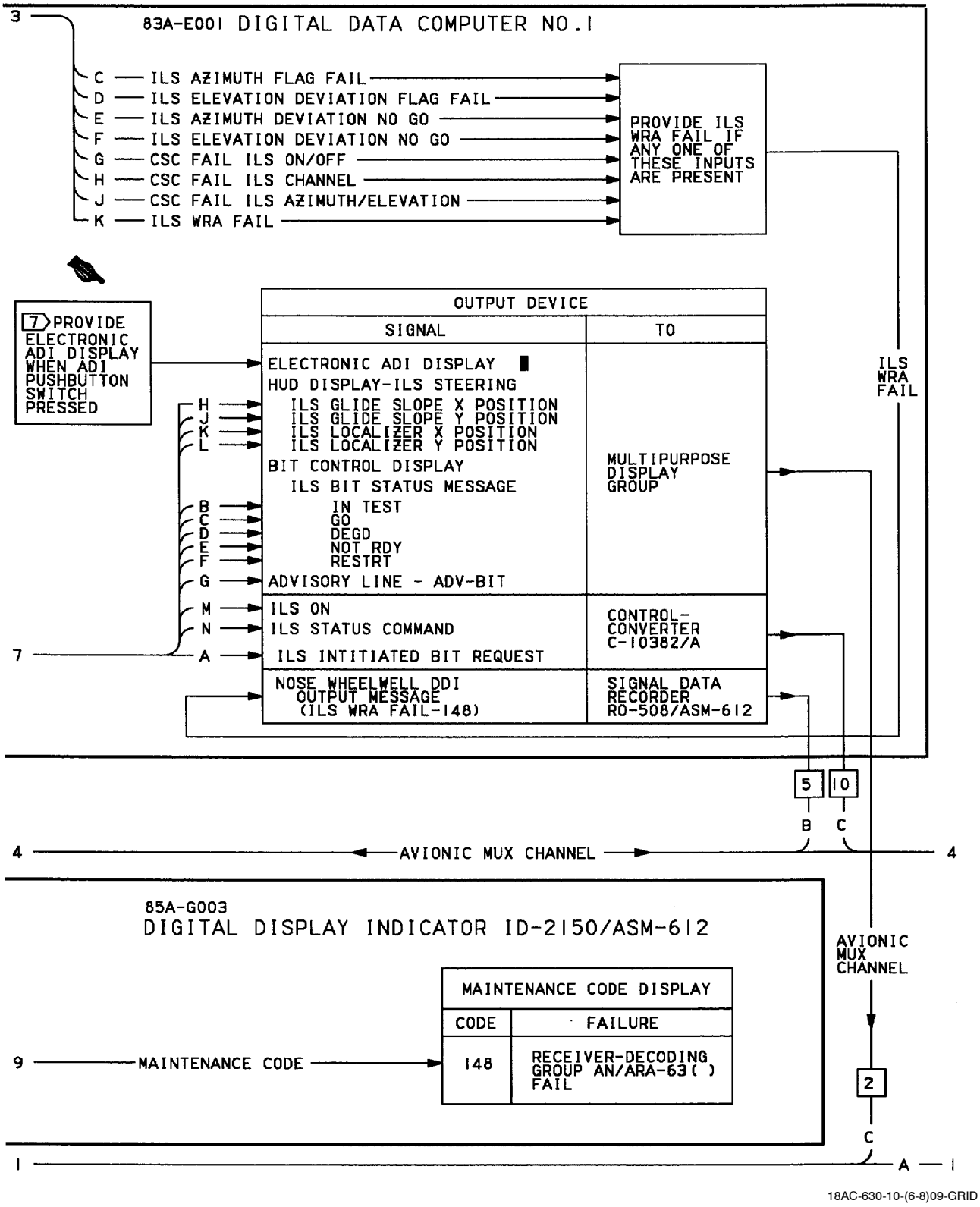


Figure 1. ILS Simplified Schematic (Sheet 7)



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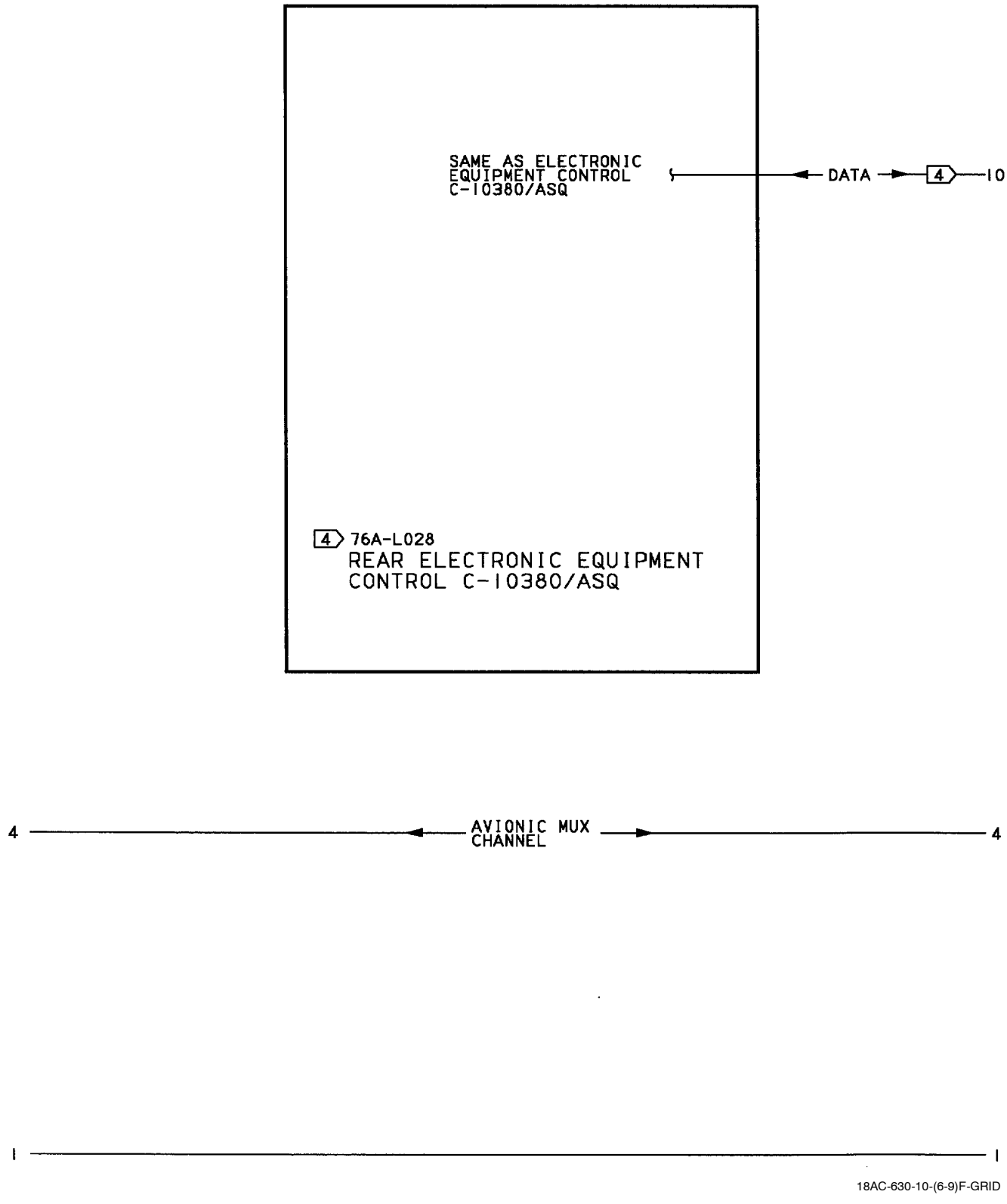


Figure 1. ILS Simplified Schematic (Sheet 9)

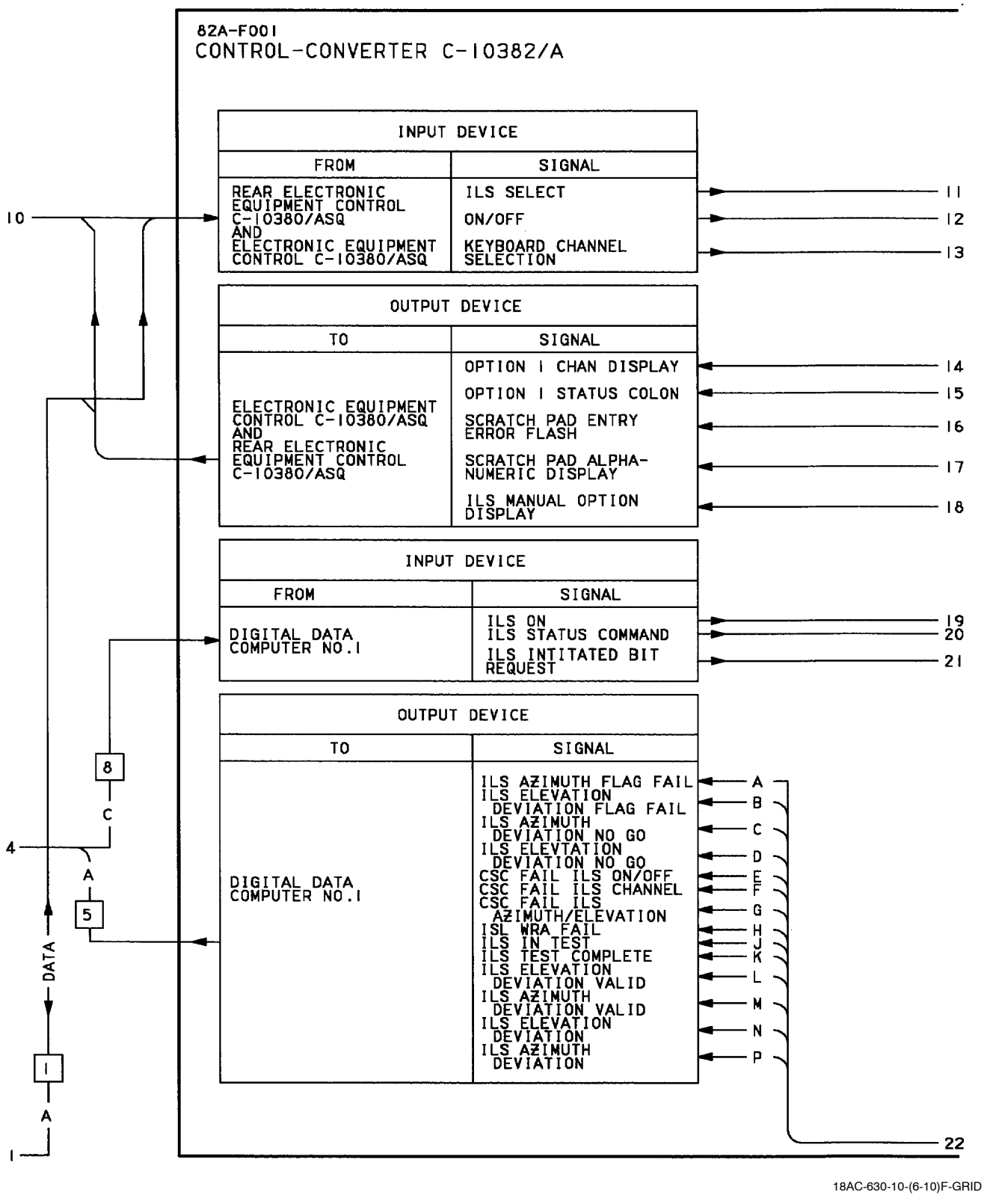


Figure 1. ILS Simplified Schematic (Sheet 10)

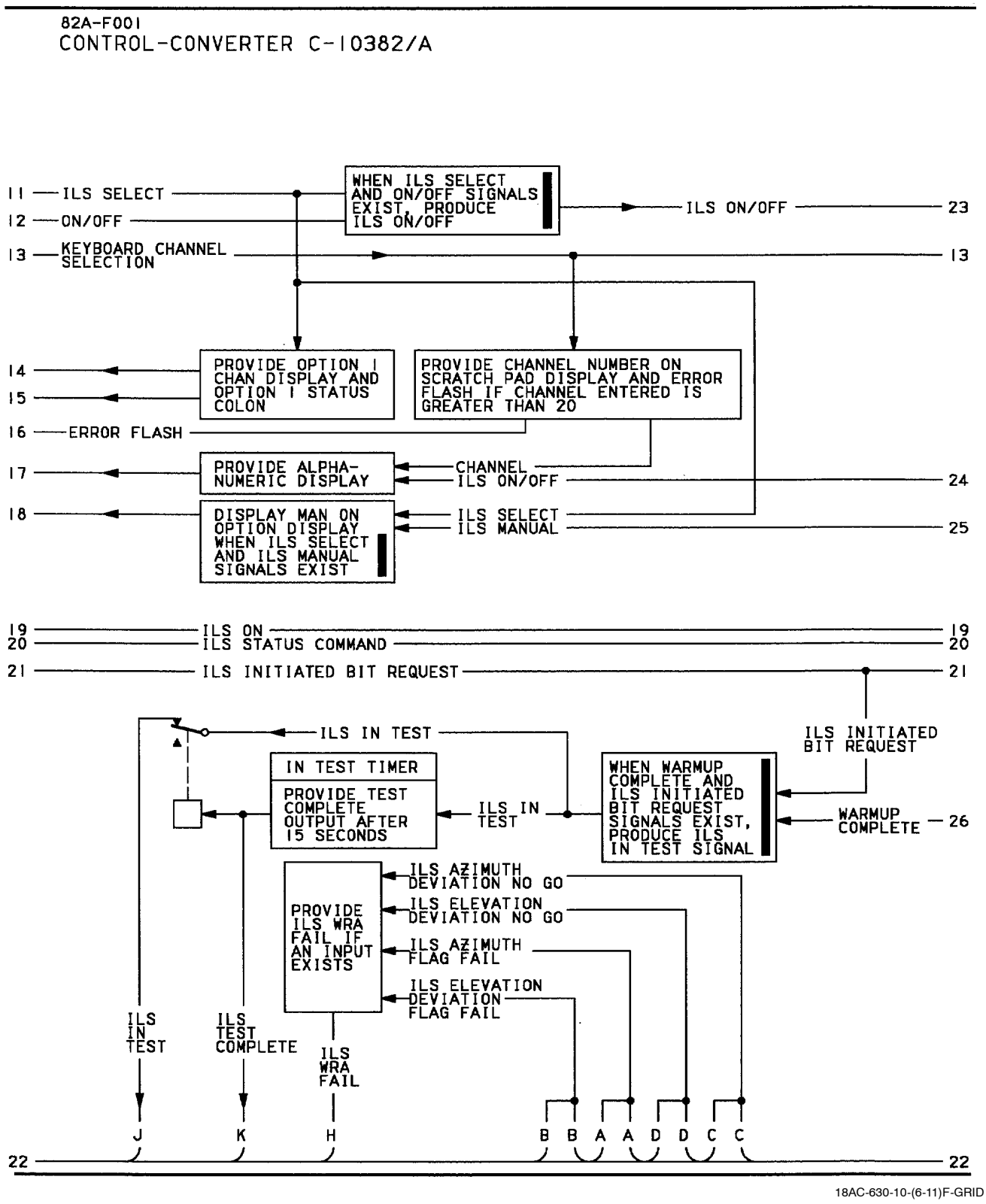


Figure 1. ILS Simplified Schematic (Sheet 11)

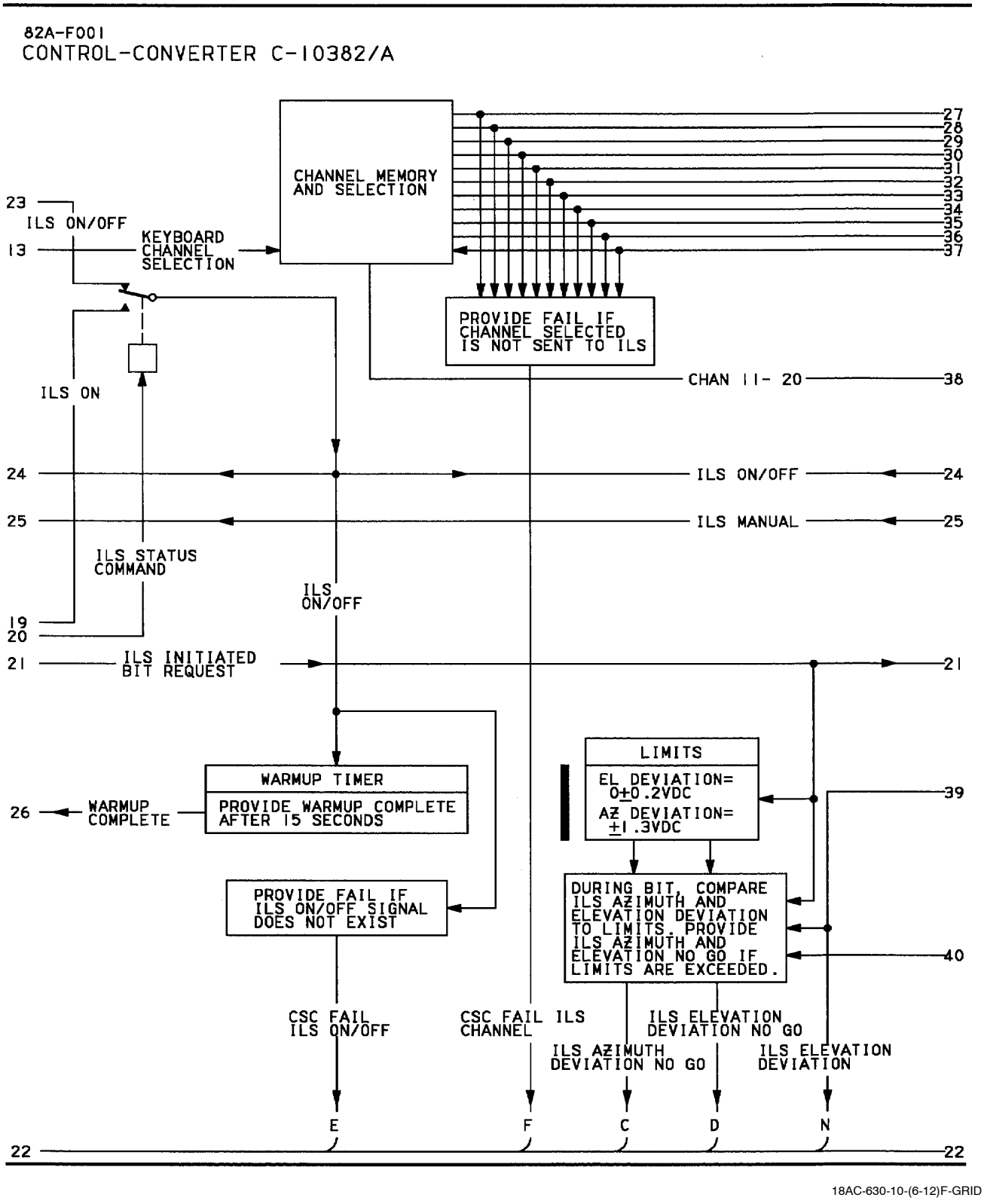


Figure 1. ILS Simplified Schematic (Sheet 12)

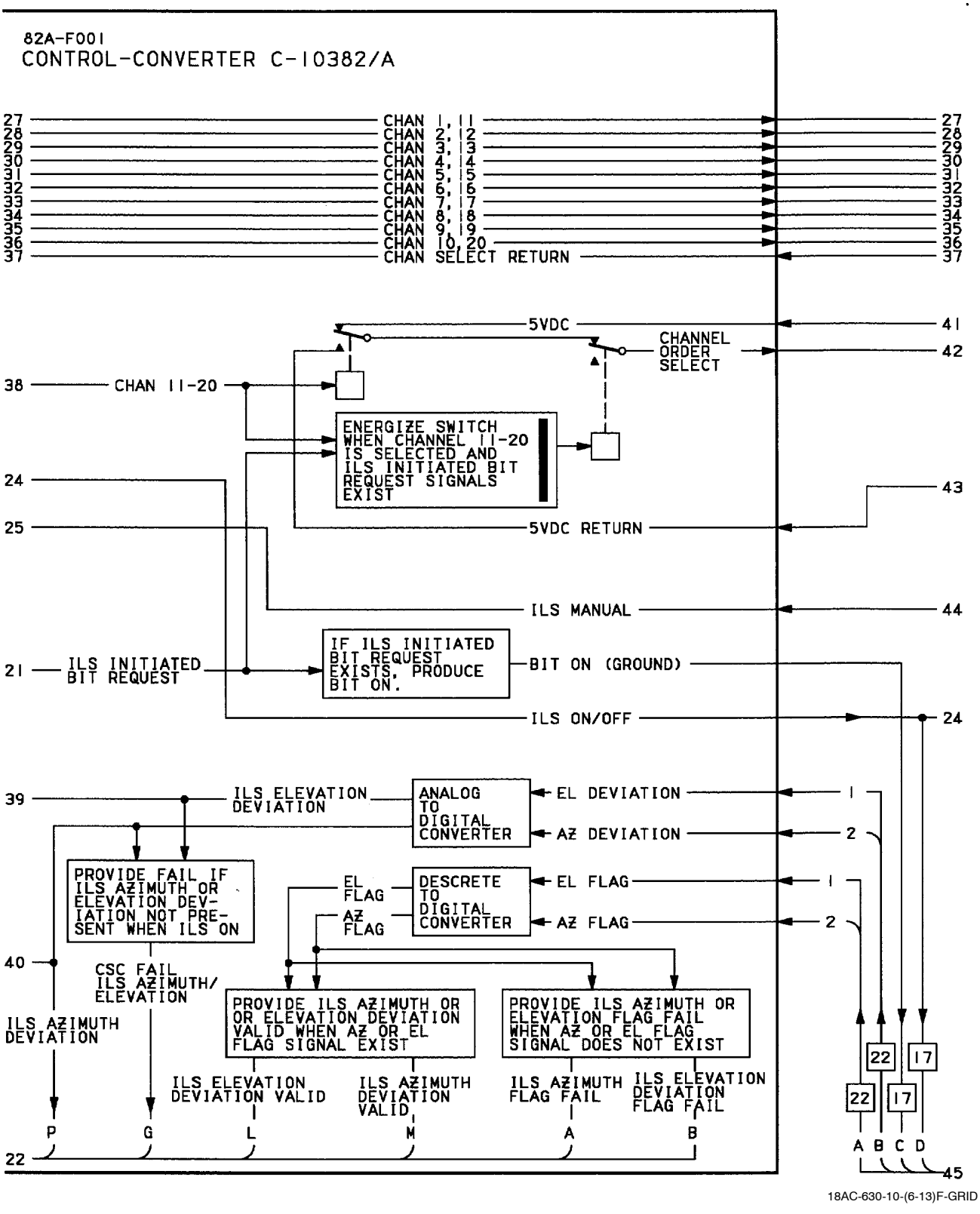


Figure 1. ILS Simplified Schematic (Sheet 13)

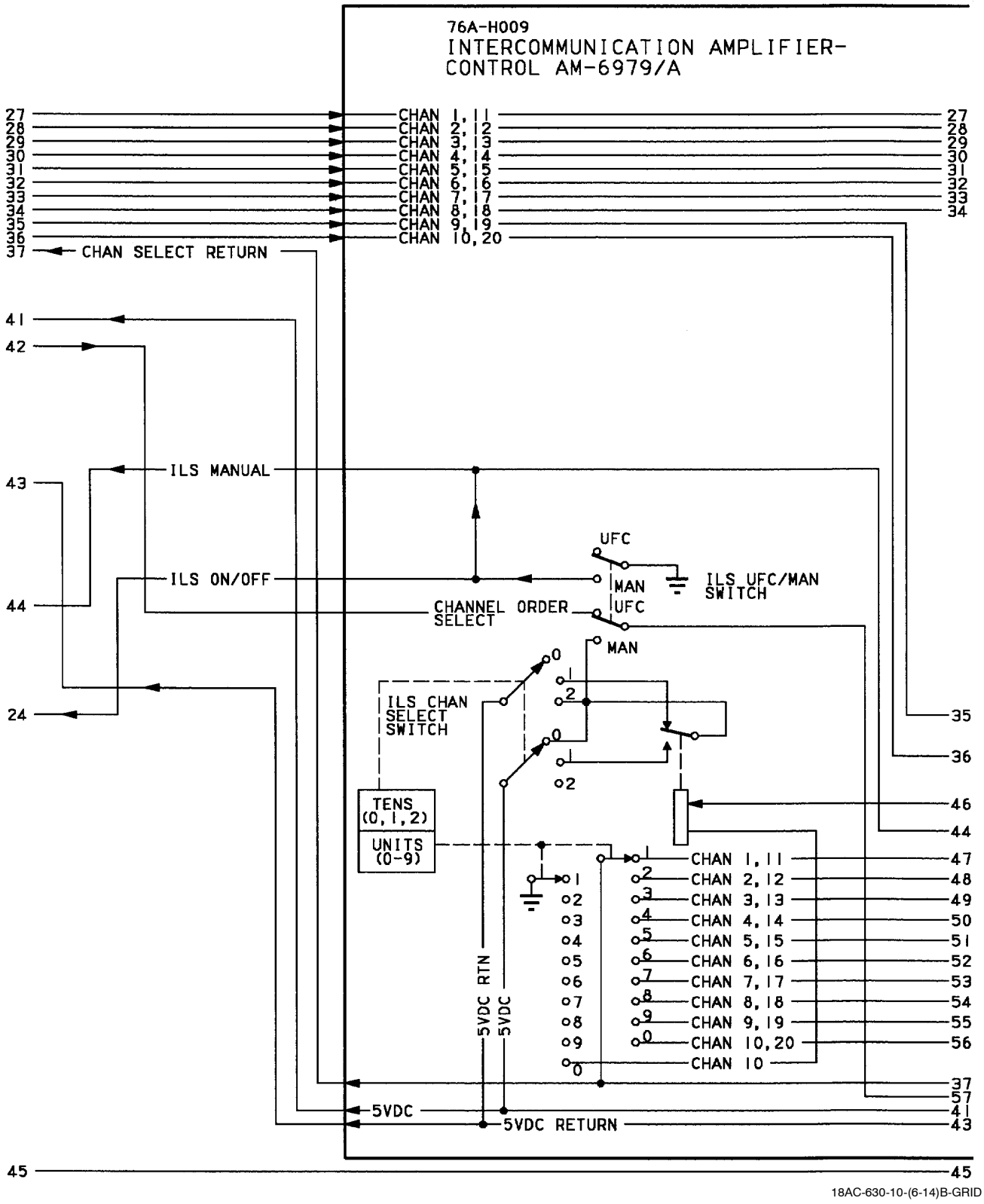


Figure 1. ILS Simplified Schematic (Sheet 14)

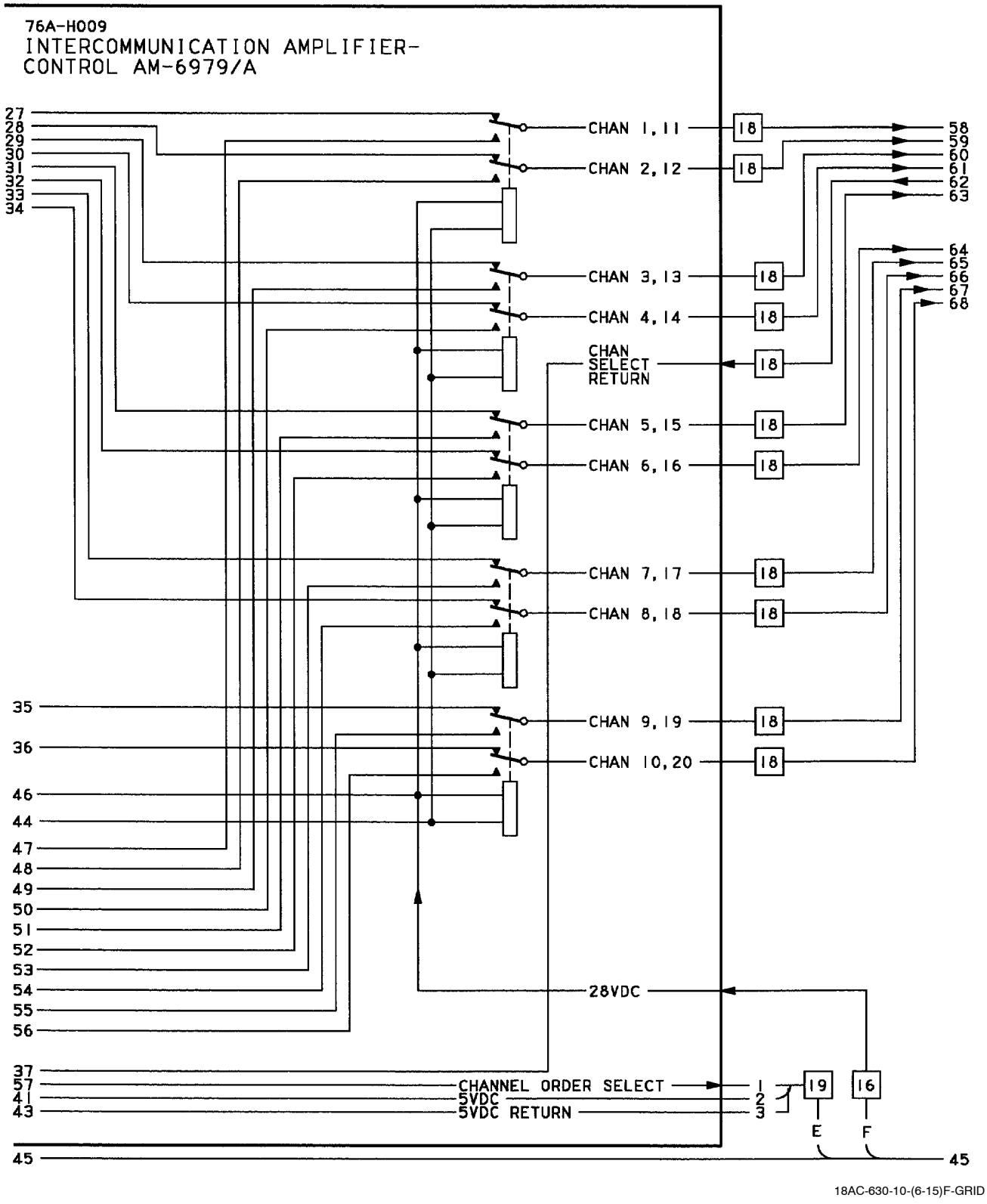


Figure 1. ILS Simplified Schematic (Sheet 15)

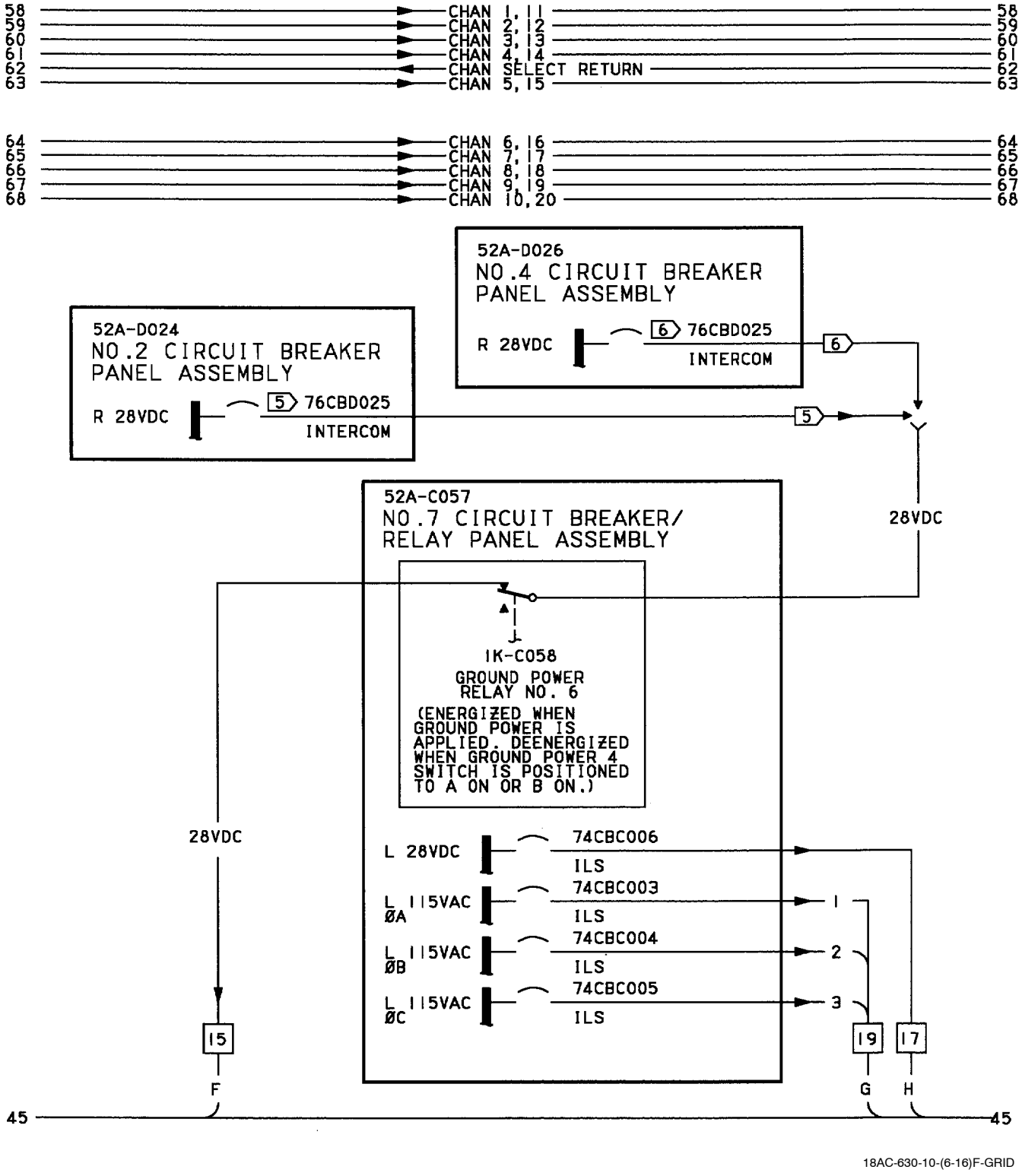


Figure 1. ILS Simplified Schematic (Sheet 16)

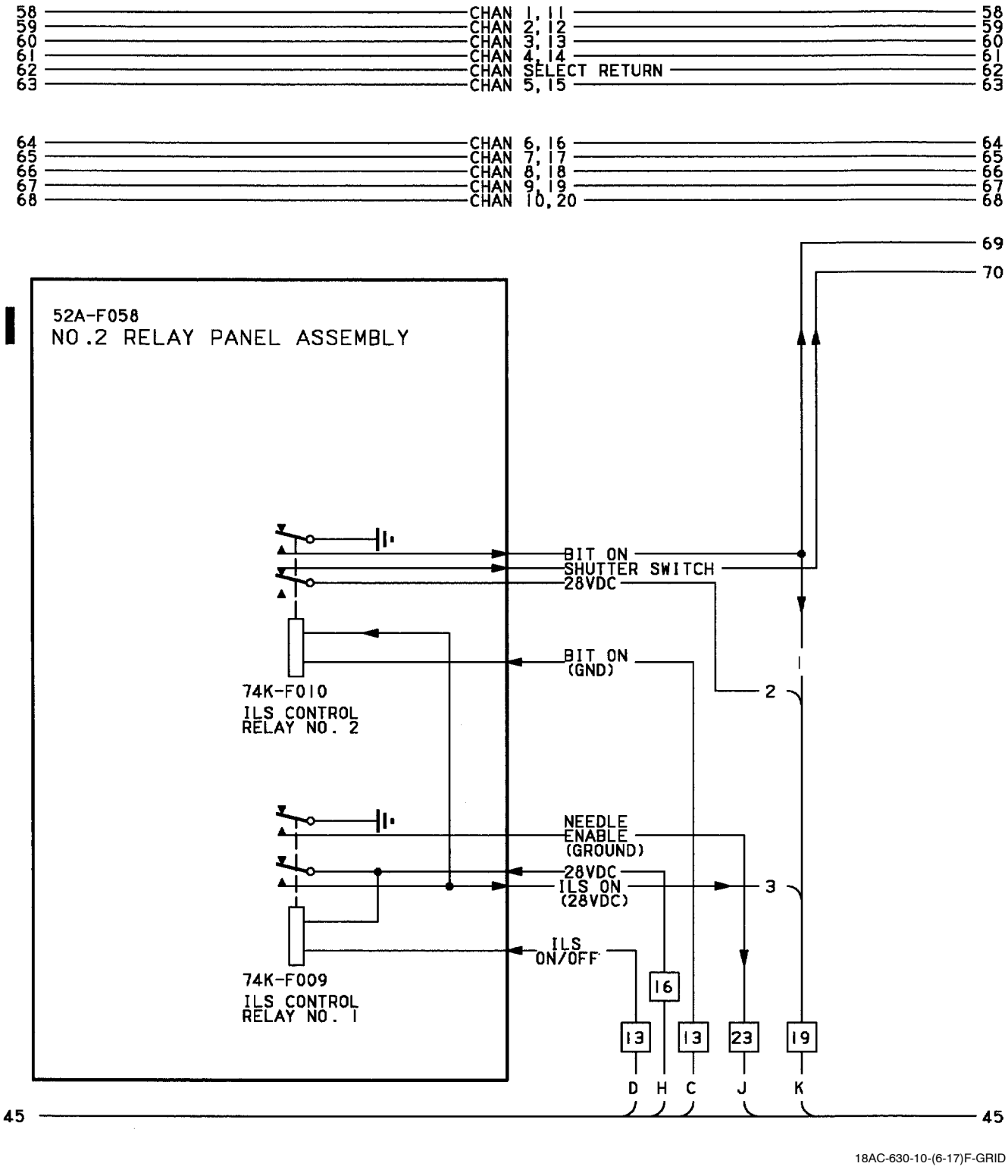


Figure 1. ILS Simplified Schematic (Sheet 17)

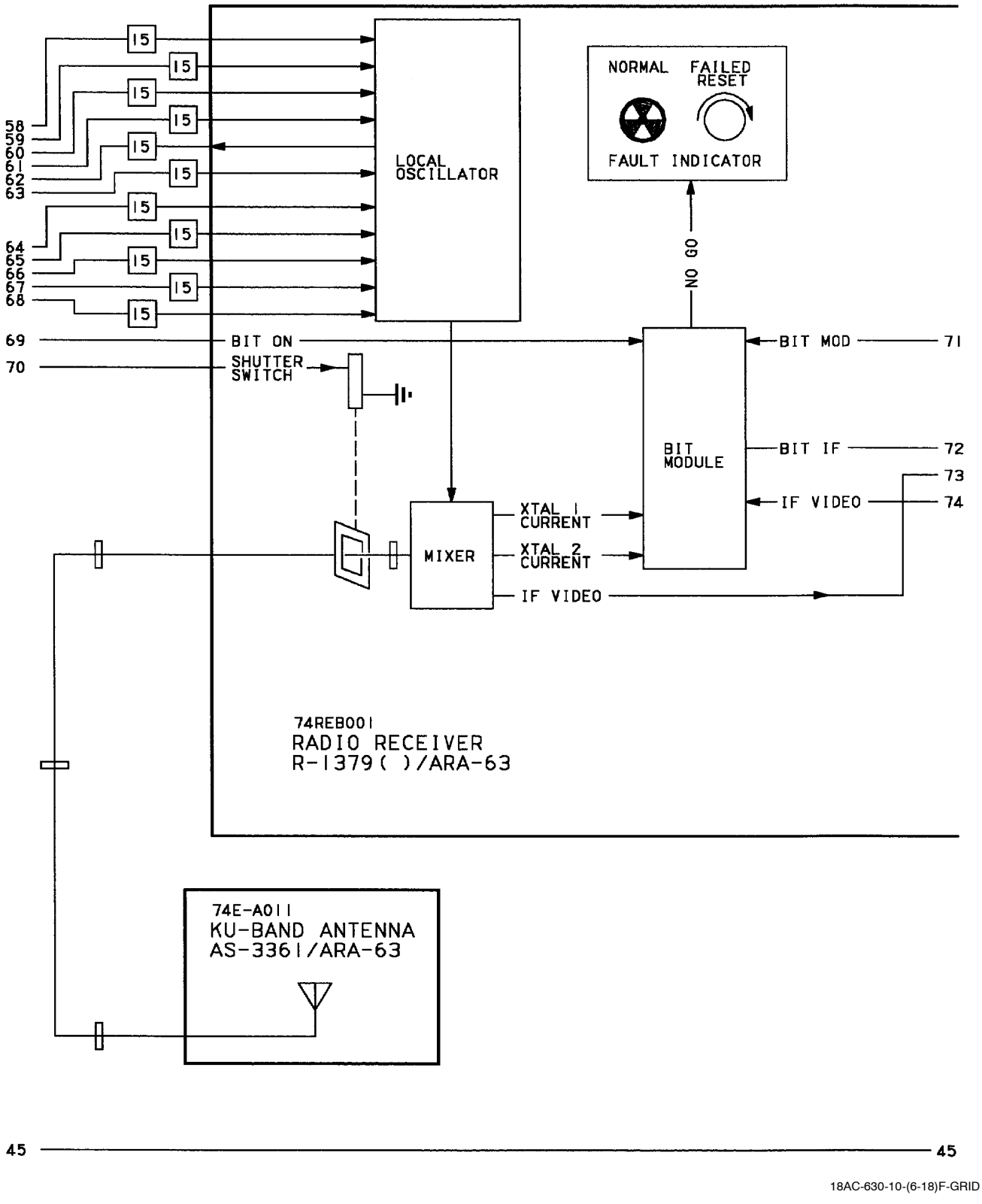


Figure 1. ILS Simplified Schematic (Sheet 18)

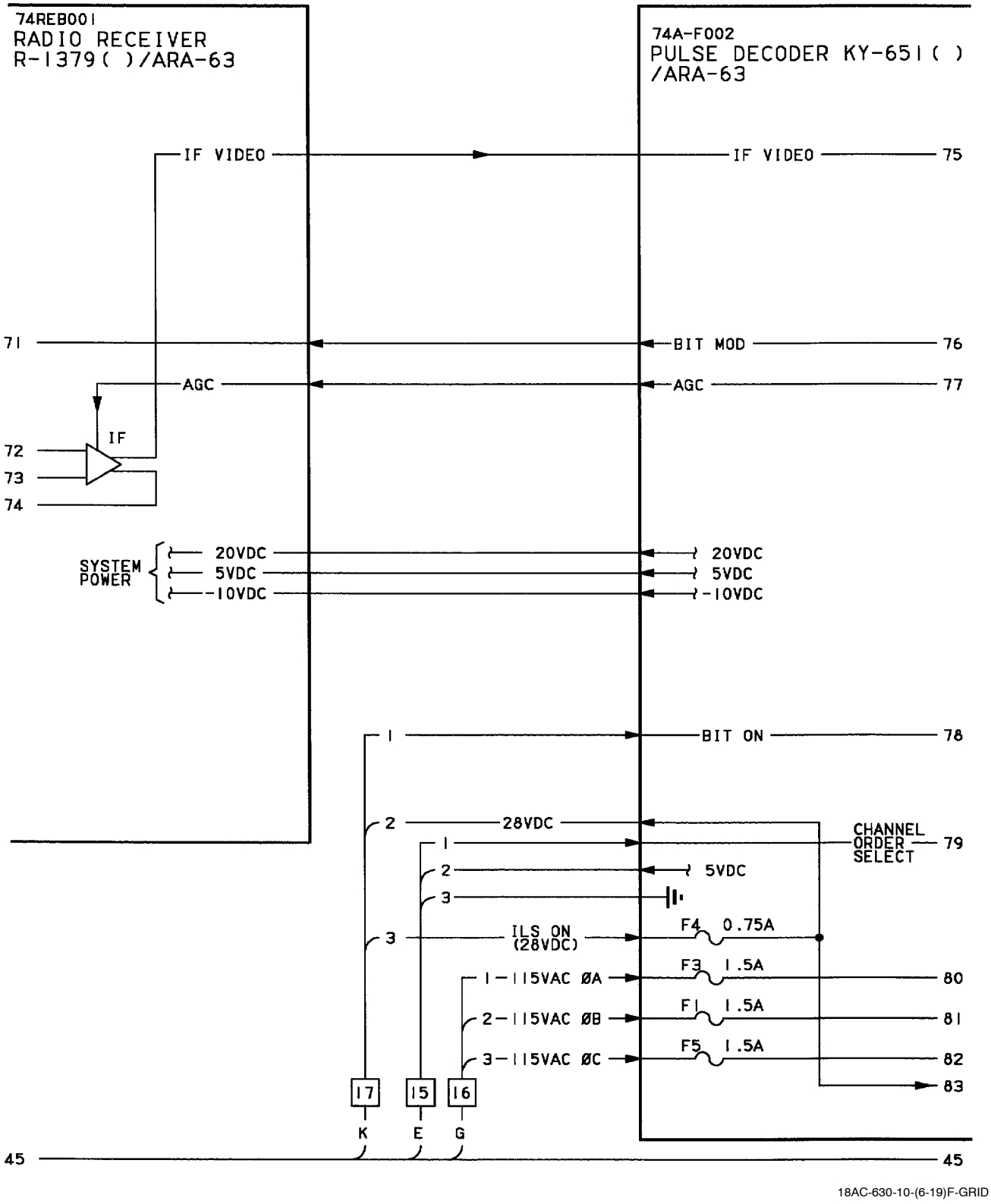


Figure 1. ILS Simplified Schematic (Sheet 19)

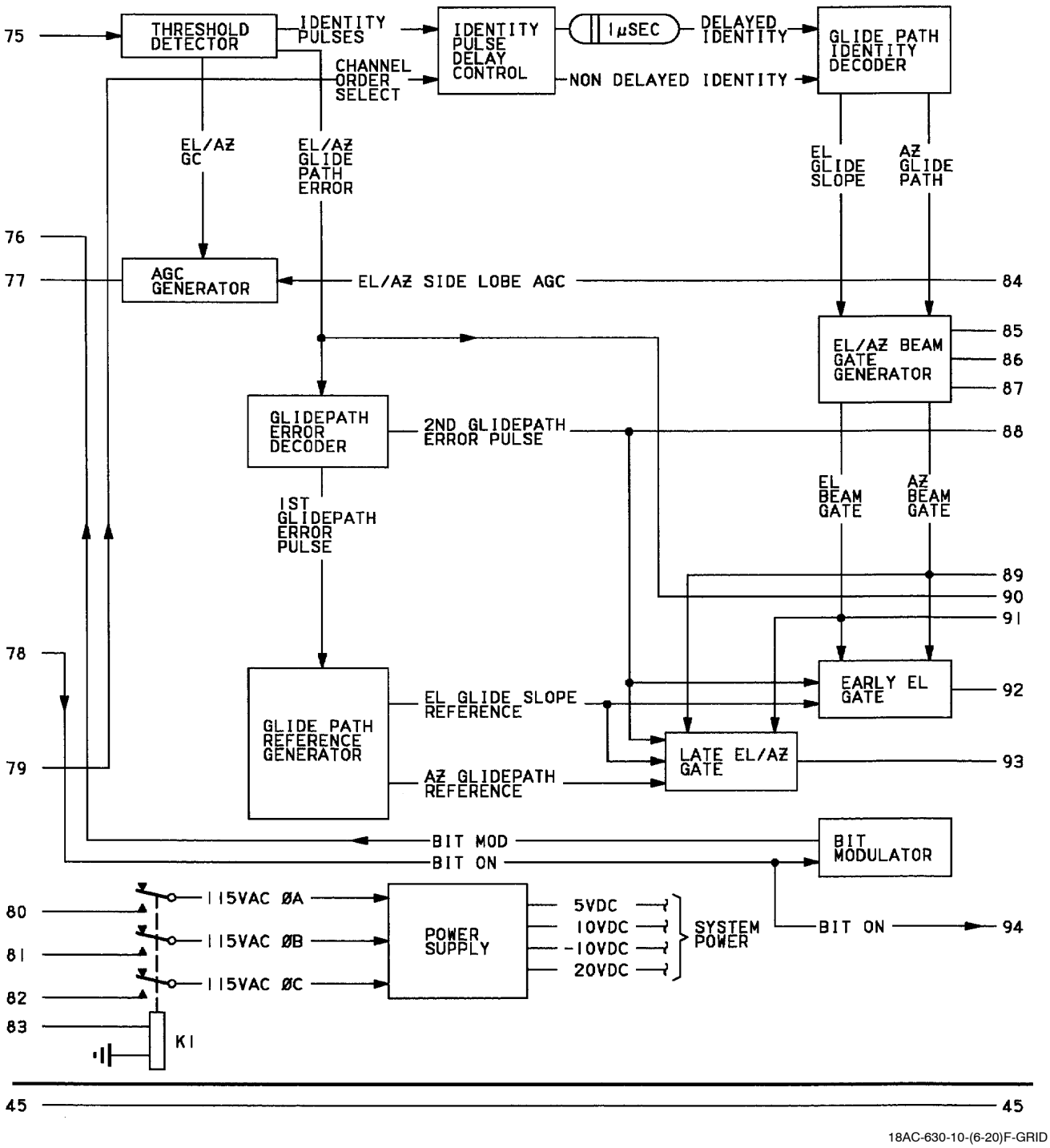


Figure 1. ILS Simplified Schematic (Sheet 20)

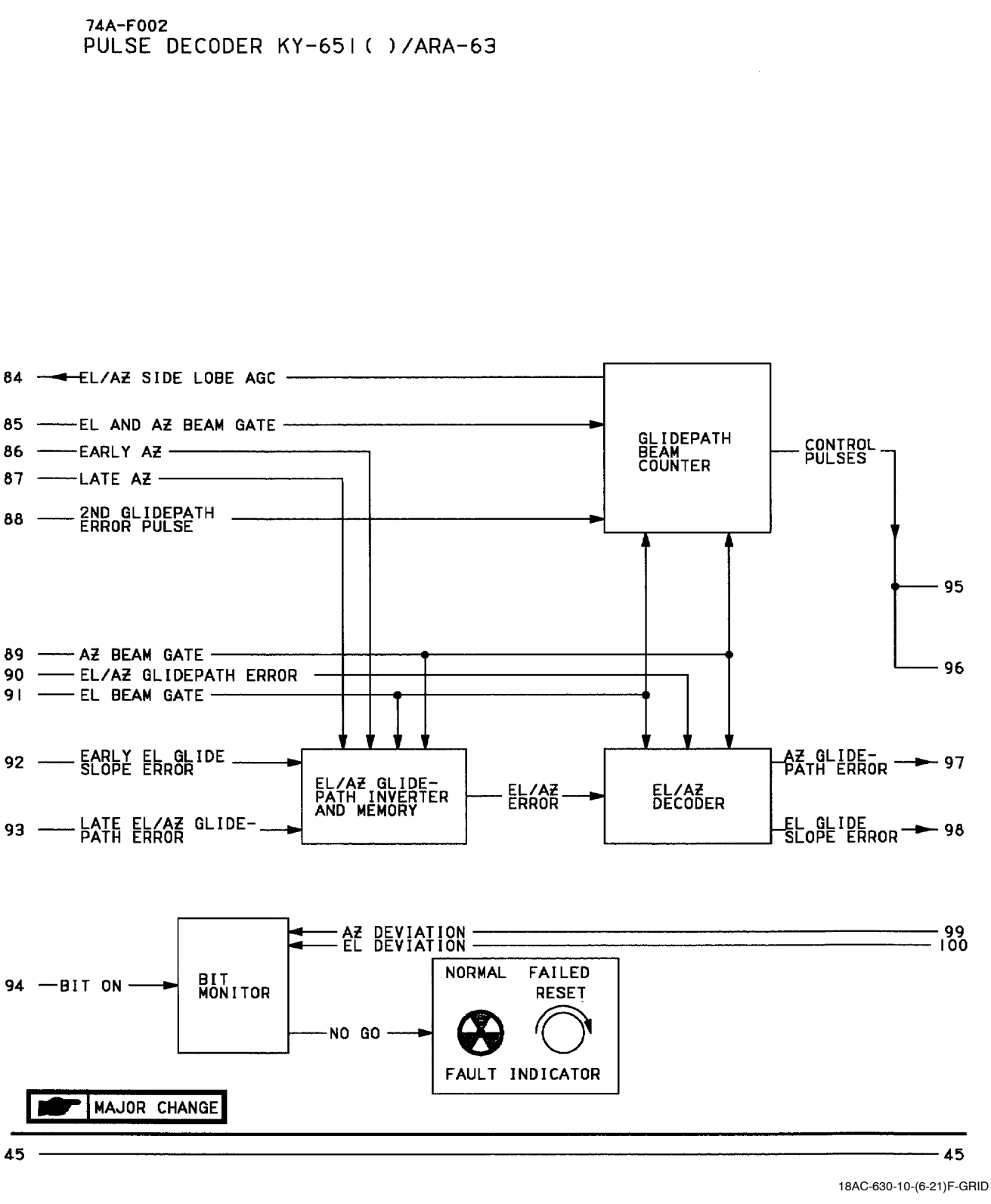


Figure 1. ILS Simplified Schematic (Sheet 21)

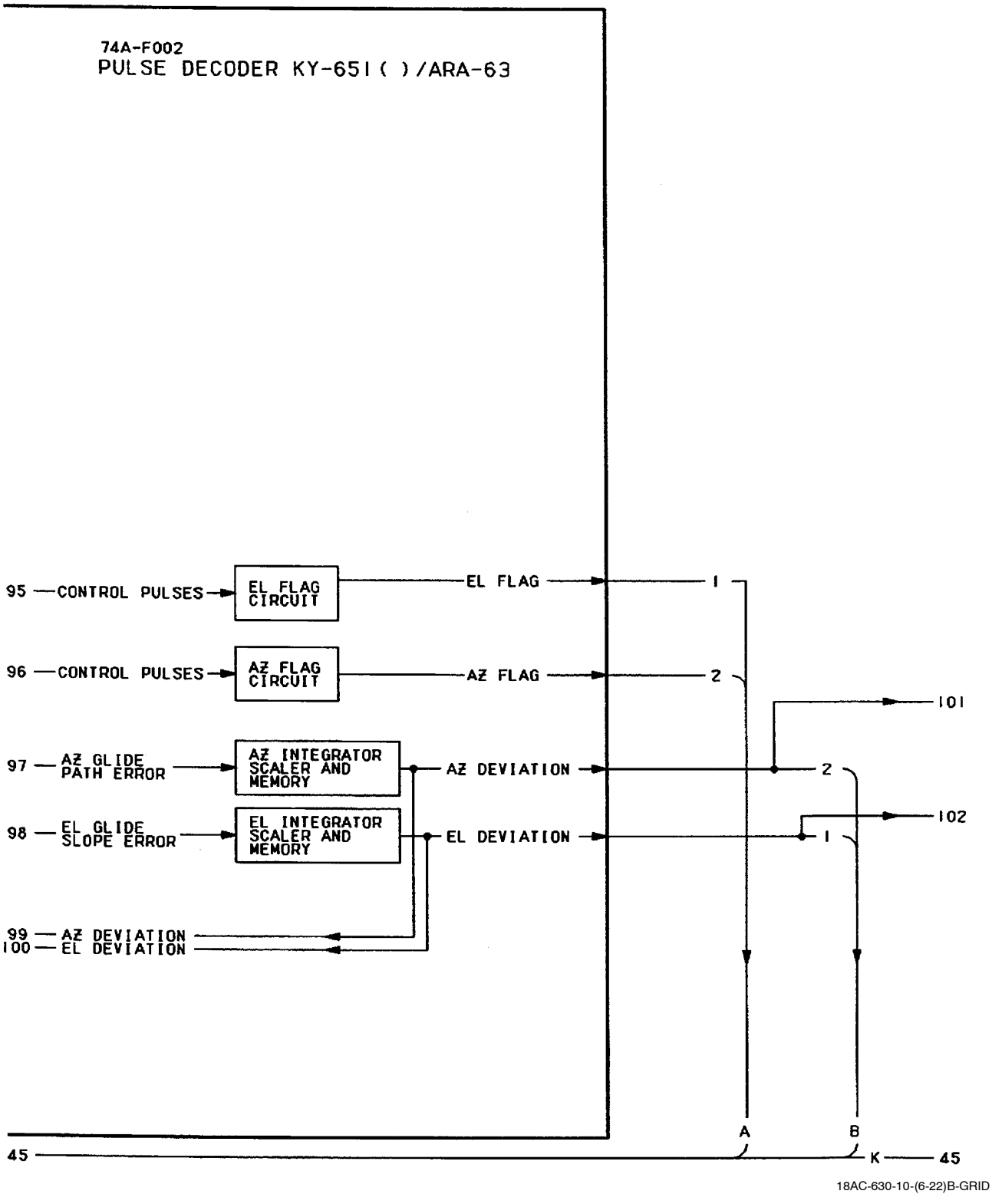
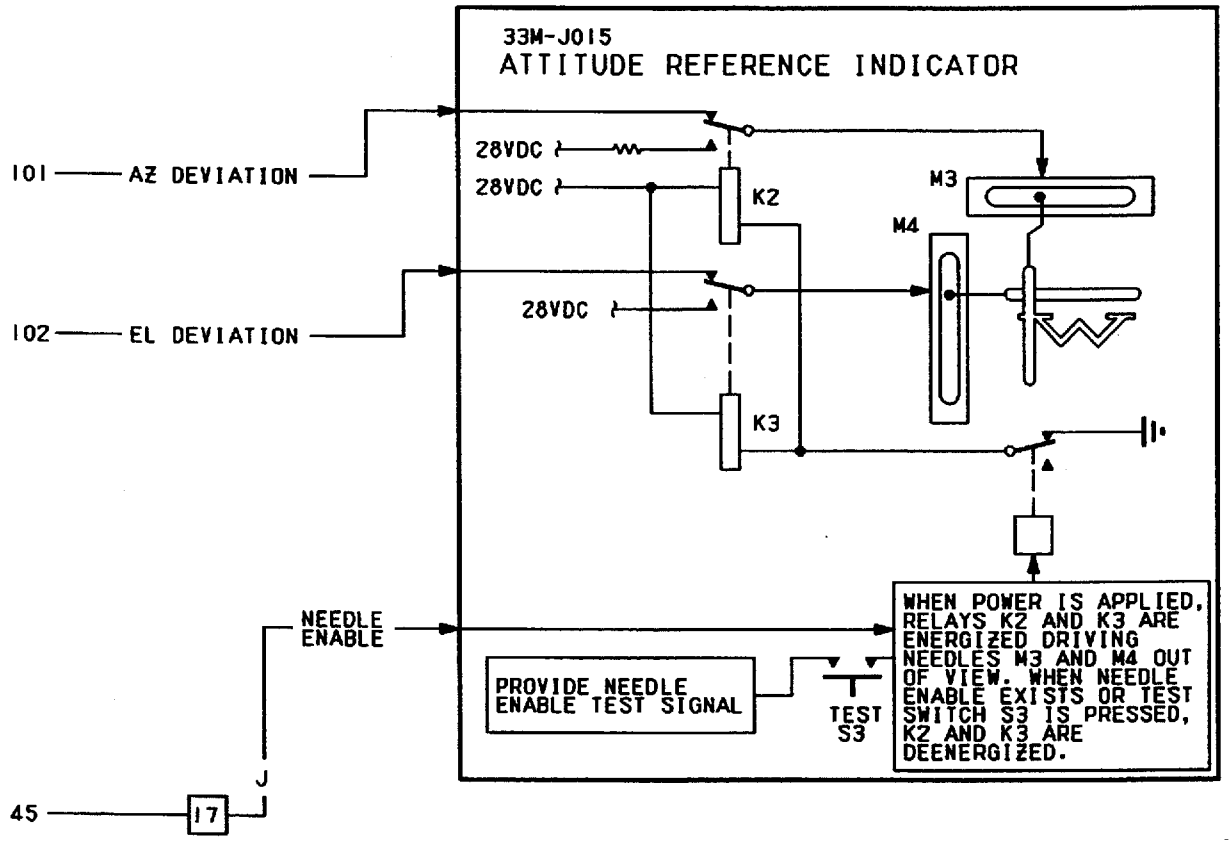


Figure 1. ILS Simplified Schematic (Sheet 22)

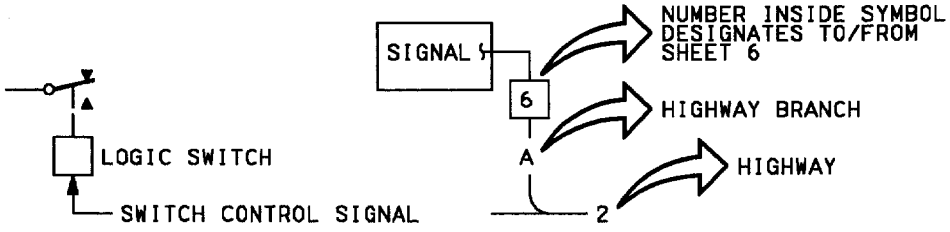


18AC-630-10-(6-23)08-GRID

Figure 1. ILS Simplified Schematic (Sheet 23)

LEGEND

1. NONSTANDARD SYMBOLS AND ABBREVIATIONS.



BIT - BUILT-IN TEST
HUD - HEAD UP DISPLAY
HSI - HORIZONTAL SITUATION INDICATOR

(2) EXPLANATION OF MATRIX

A. COMPUTE COLUMN LISTS THE SIGNAL OUTPUT.

B. INPUTS REQUIRED ARE USED TO DEVELOP THE SIGNAL OUTPUT.

C. THE SIGNAL OUTPUT IS READ HORIZONTALLY. EACH HORIZONTAL LINE IS AN INDEPENDENT SIGNAL OUTPUT.

D. INTERPRET MATRIX TABLE AS INDICATED.

(1) ONE (1) INDICATES THIS INPUT AS NAMED MUST BE THERE TO GET THE OUTPUT.

(2) ZERO (0) INDICATES THIS INPUT AS NAMED MUST NOT BE THERE TO GET THE OUTPUT.

(3) DASH (-) INDICATES THE OUTPUT DOES NOT DEPEND ON THIS INPUT.

(3) THE MULTIPURPOSE DISPLAY GROUP IS MADE UP OF THE LEFT DIGITAL DISPLAY INDICATOR IP-1317( ), RIGHT DIGITAL DISPLAY INDICATOR IP-1317( ), HEAD-UP DISPLAY UNIT AN/AVQ-28, HORIZONTAL INDICATOR IP-1350/A, AND ON TF/A-18A THE REAR LEFT DIGITAL DISPLAY INDICATOR IP-1318( ), REAR RIGHT DIGITAL DISPLAY INDICATOR IP-1318( ), AND REAR CENTER DIGITAL DISPLAY INDICATOR IP-1318( ).

(4) F/A-18B

(5) 161353 THRU 161359

(6) 161360 AND UP

(7) WITH DIGITAL DATA COMPUTER IDENT. 89A AND UP

18AC-630-10-(6-24)09-GRID

Figure 1. ILS Simplified Schematic (Sheet 24)

ORGANIZATIONAL MAINTENANCE

PRINCIPLES OF OPERATION

DESCRIPTION - SYSTEM

RADAR BEACON SYSTEM

This WP supersedes WP008 00, dated 1 May 1986.

Reference Material

Alphabetical Index

Record of Applicable Technical Directives

None

1. INTRODUCTION.

2. Discussion of the Radar Beacon System (radar beacon) description is divided into the below:

a. system description

b. component description

c. controls and indicators

3. SYSTEM DESCRIPTION.

4. The radar beacon is used to improve the tracking capabilities of surface radar and the automatic carrier landing system (ACLS). The radar beacon has two primary modes of operation; normal mode (NORM) and automatic carrier landing mode (ACL).

5. In NORM, the radar beacon is used to extend the tracking range of surface radar. Surface radar transmits X-band signals to the radar beacon. The radar beacon responds by transmitting pulsed

replies of greater strength in the same frequency band.

6. In ACL, surface radar transmits a conically scanning KA-band radar beam to the radar beacon. The radar beacon receives, amplifies, and then transmits these signals in the X-band to the surface radar. There, range, angle tracking, and position error is derived and used for aircraft data link guidance.

7. COMPONENT DESCRIPTION.

8. The radar beacon system is made up of:

a. Radar Receiver.

b. Radar Receiver-Transmitter

c. KA-Band Antenna

d. X-Band Antenna

e. KA-band waveguide assembly

For locator, refer to WP009 00.

9. **RADAR RECEIVER.** Surface radar transmits a conically scanning KA-band radar beam to the aircraft in ACL mode. During ACL and NORM modes, the radar receiver (receiver) is used. If the aircraft is out of position, it is detected by the receiver.

10. When position error is detected by the receiver, it produces an amplitude modulated envelope called spin error. The amplitude of the spin error produced by the receiver is proportional to the position error. The receiver applies the spin error to radar receiver-transmitter for transmission to surface radar. The receiver has BIT circuitry for system BIT testing.

11. **RADAR RECEIVER-TRANSMITTER.** During ACL mode, the radar receiver transmitter is used.

12. In NORM, the receiver-transmitter extends the tracking range of surface radar. X-band signals transmitted by surface radar are received by the receiver-transmitter. The receiver-transmitter responds by transmitting strengthened pulse replies in the same frequency band.

13. In ACL, the receiver-transmitter is used to improve the tracking of the ACLS. The receiver-transmitter produces X-band reply signals which are modulated by spin error from the receiver. The reply signals are transmitted to the surface radar receiver to be used for range and angle tracking.

14. The receiver-transmitter also operates in a standby (STBY) mode. When in STBY, the receiver-transmitter is turned on, but is not allowed to transmit. The receiver-transmitter has BIT circuitry for system BIT testing.

15. **KA-BAND ANTENNA.** Interrogation signals to the receiver in the KA frequency band are received by the KA-band antenna.

16. **X-BAND ANTENNA.** Received and transmitted signals to the receiver-transmitter in the X frequency band are handled by the X-Band antenna

17. **KA-BAND COAX/WAVEGUIDE ASSEMBLY.** The KA-band coax/waveguide assembly transmits KA-band interrogation signals from the KA-band antenna to the receiver.

18. CONTROLS AND INDICATORS.

19. See table 1. Refer to WP009 00 for locator.

Table 1. Controls and Indicators

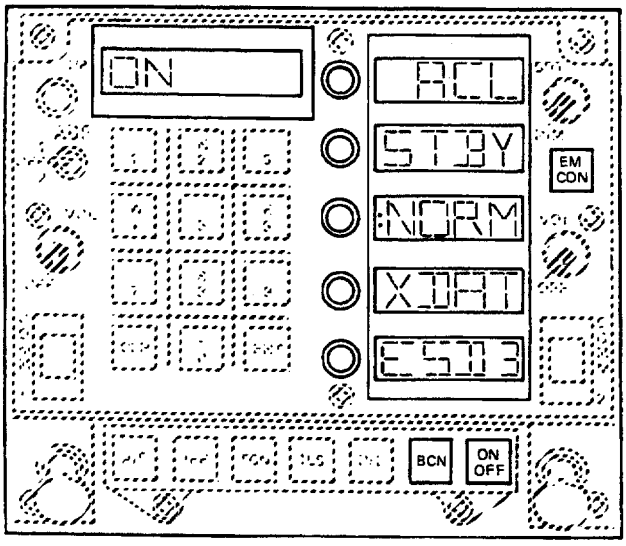
Control/Indicator	Function
1. GND PWR control panel assembly.	
a. 1 switch	When in A ON, applies power to digital data computer No. 1. For other systems powered by 1 switch, refer to ground power switching description (A1-F18AC-420-100, WP005 00).
b. 2 switch	When in B ON, applies power to the radar beacon system. For other systems powered by 2 switch, refer to ground power switching description (A1-F18AC-420-100, WP005 00).
2. Electronic Equipment Control (fig 1).	
a. ON/OFF switch.	Turns radar beacon system on or off after first pressing BCN function select switch.
b. BCN function select switch	Enables BCN options to be displayed on option displays and BCN status (ON/OFF) to be displayed on scratch pad display.
c. Mode option display	
(1) ACL	Selects automatic carrier landing mode of operation. Permits reception in KA-band by the receiver and transmission in X-band by the receiver-transmitter.
(2) STBY	Selects standby mode of operation. Receiver-transmitter output is inhibited.
(3) NORM	Selects normal mode of operation. Receiver-transmitter receives single or coded double-pulse X-band signals and transmits single or coded double-pulse replies in the X-band.
(4) XDAT	Not used.
(5) E(X)D(Y)	Displays encode and decode codes - (X) and (Y). When selected, encode and decode options are shown on the option displays.
d. Encode/decode option display.	Provided when E(X)D(Y) selected on mode option display.
(1) ESGL	Selects single-pulse encoding. When pressed, S is displayed in (X) window of E(X)D(Y) option on mode option display.
(2) EDBL	Selects one of five double-pulse codes. When pressed, five encode double codes are shown on option displays.

Table 1. Controls and Indicators (Continued)

Control/Indicator	Function
(3) DSGL	Selects single-pulse decoding. When pressed, S is displayed in (Y) window of E(X)D(Y) option on mode option display.
(4) DDBL	Selects one of five double-pulse codes. When pressed, five decode double codes are shown on option displays.
e. EDBL/DDBL code option display.	Provided when EDBL or DDBL selected on encode/decode option display. After code is selected, option displays revert to mode option displays.
(1) 1	Selects double-pulse code of 1.
(2) 2	Selects double-pulse code of 2.
(3) 3	Selects double-pulse code of 3.
(4) 4	Selects double-pulse code of 4.
(5) 5	Selects double-pulse code of 5.
f. EMCON select switch	When pressed, the receiver is turned off and the receiver-transmitter is set to STBY. EMCON is displayed on option display.
g. EMCON option display	Displayed when EMCON select switch is pressed. When EMCON select switch is pressed again, the radar beacon system returns to normal operation and display disappears.
h. Scratch pad display	Indicates BCN status (ON/OFF).
3. Left Digital Display Indicator	
a. MENU pushbutton switch	Provides MENU display.
b. MENU display	Provides control for selection of displays on left Digital Display Indicator.
(1) BIT pushbutton switch	Provides BIT control display.
(2) HSI pushbutton switch	Provides HSI display.
c. BIT control display	Indicates BIT status of radar beacon system.
(1) ILS/AUG/BCN/D/L pushbutton switch	Initiates BIT of radar beacon system.
4. Right Digital Display Indicator	Provides same functions as described for left Digital Display Indicator.

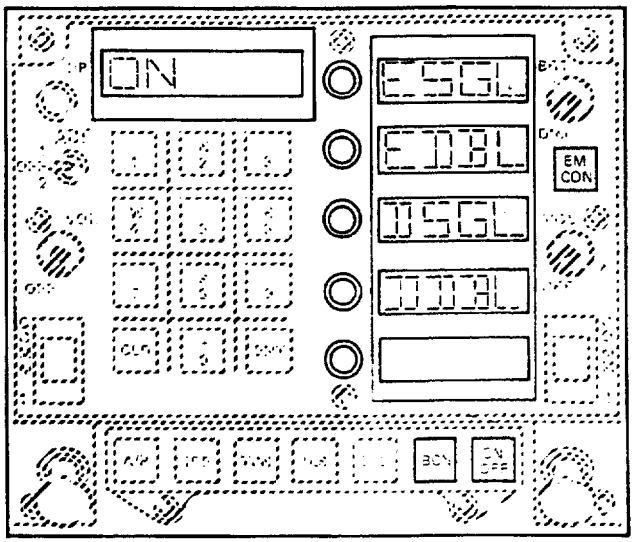
Table 1. Controls and Indicators (Continued)

Control/Indicator	Function
5. Horizontal Indicator	
a. HSI display	Provides navigation information and steering options for display on head-up display Unit (HUD).
(1) ACL pushbutton switch	Used in the navigation master mode along with data link system. When pressed, the radar beacon system is automatically turned on.
6. Radar Receiver	
a. FAULT IND latch	Normally black. Latches to white for failure.
7. Radar Receiver-Transmitter	
a. BIT latch	Normally black. Latches to white for failure.
8. Digital Display Indicator	
a. MAINTENANCE CODE display	Three digit light-emitting diode display. Displays maintenance codes stored in digital display indicator when MAINTENANCE CODE DISPLAY switch is pressed. Radar beacon maintenance codes are: 151 - Radar Receiver 153 - Radar Receiver-Transmitter
b. WPN SYS FAIL indicator	Latch type indicator. Sets to fault (black and white) when maintenance codes are stored in nose wheelwell DDI.



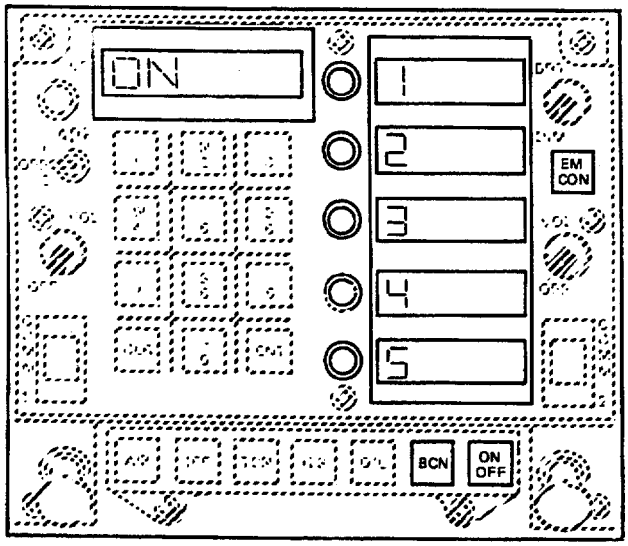
MODE OPTION DISPLAY

DISPLAYS MODES AVAILABLE TO RADAR BEACON SYSTEM. DISPLAYED WHEN BCN FUNCTION SELECT SWITCH IS PRESSED. A COLON APPEARS BESIDE THE MODE SELECTED. THE LAST OPTION INDICATES THE ENCODE AND DECODE CODES BEING USED. IN THIS EXAMPLE, ENCODE SINGLE AND DECODE DOUBLE 3. WHEN PRESSED, THE DISPLAY CHANGES TO ENCODE/DECODE DISPLAY



ENCODE/DECODE OPTION DISPLAY

DISPLAYS ENCODE/DECODE OPTIONS WHEN OPTION 5 SELECTED ON MODE OPTION DISPLAY. IF ESGL OR DSGL SELECTED ON ENCODE/DECODE OPTION DISPLAY, DISPLAY CHANGES TO MODE OPTION DISPLAY, WITH AN S DISPLAYED IN OPTION 5. IF EDBL OR DDBL SELECTED ON ENCODE/DECODE OPTION DISPLAY, DISPLAY CHANGES TO EDBL/DDBL CODE OPTION DISPLAY.

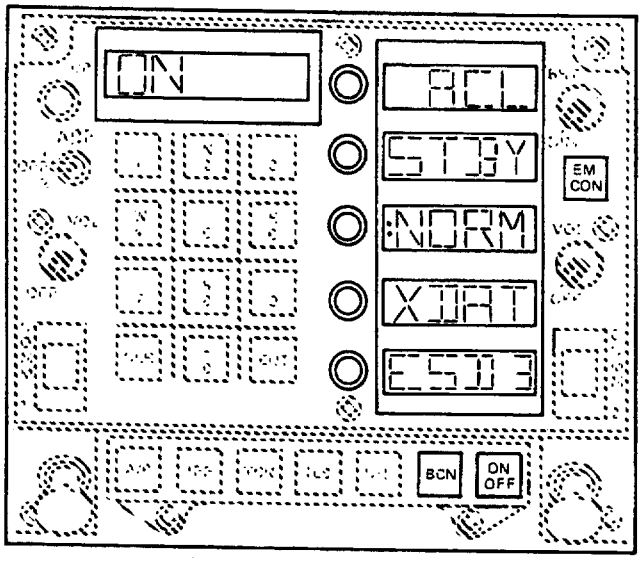


EDBL/DDBL CODE OPTION DISPLAY

DISPLAY CODES AVAILABLE FOR ENCODING AND DECODING WHEN EDBL OR DDBL SELECTED ON ENCODE/DECODE DISPLAY. WHEN ONE OF FIVE CODES IS SELECTED, EDBL/DDBL CODE OPTION DISPLAY CHANGES TO MODE OPTION DISPLAY WITH THE CODE DISPLAYED IN OPTION 5.

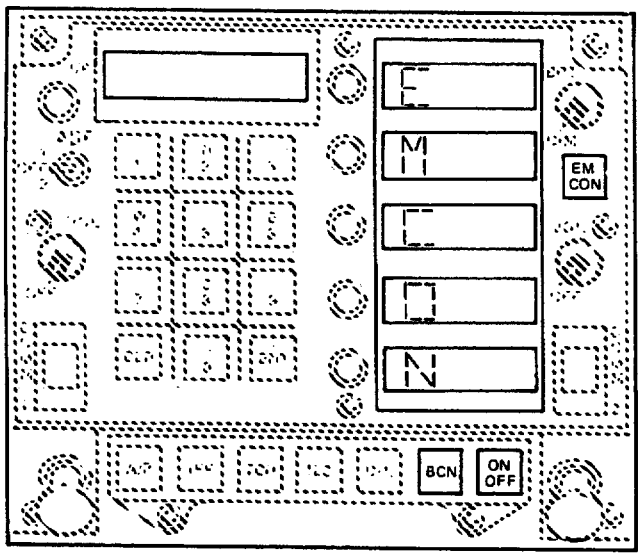
18AC-630-10-(4-1)A

Figure 1. Electronic Equipment Control Displays (Sheet 1)



RADAR BEACON DISPLAY

IF EMCON IS SELECTED ON EQUIPMENT CONTROL, DISPLAY CHANGES TO EMISSION CONTROL DISPLAY, PREVENTING THE RADAR BEACON FROM TRANSMITTING.



EMISSION CONTROL DISPLAY

DISPLAYED WHEN EMCON SELECTED ON EQUIPMENT CONTROL. TO DESELECT EMCON, PRESS THE EMCON SWITCH AGAIN. DISPLAY CHANGES TO RADAR BEACON DISPLAY. RADAR BEACON RETURNS TO NORMAL OPERATION.

18AC-630-10-(4-2)A

Figure 1. Electronic Equipment Control Displays (Sheet 2)

ORGANIZATIONAL MAINTENANCE

PRINCIPLES OF OPERATION

LOCATOR

RADAR BEACON SYSTEM

This WP supersedes WP009 00, dated 1 May 1986.

Reference Material

None

Alphabetical Index

Record of Applicable Technical Directives

None

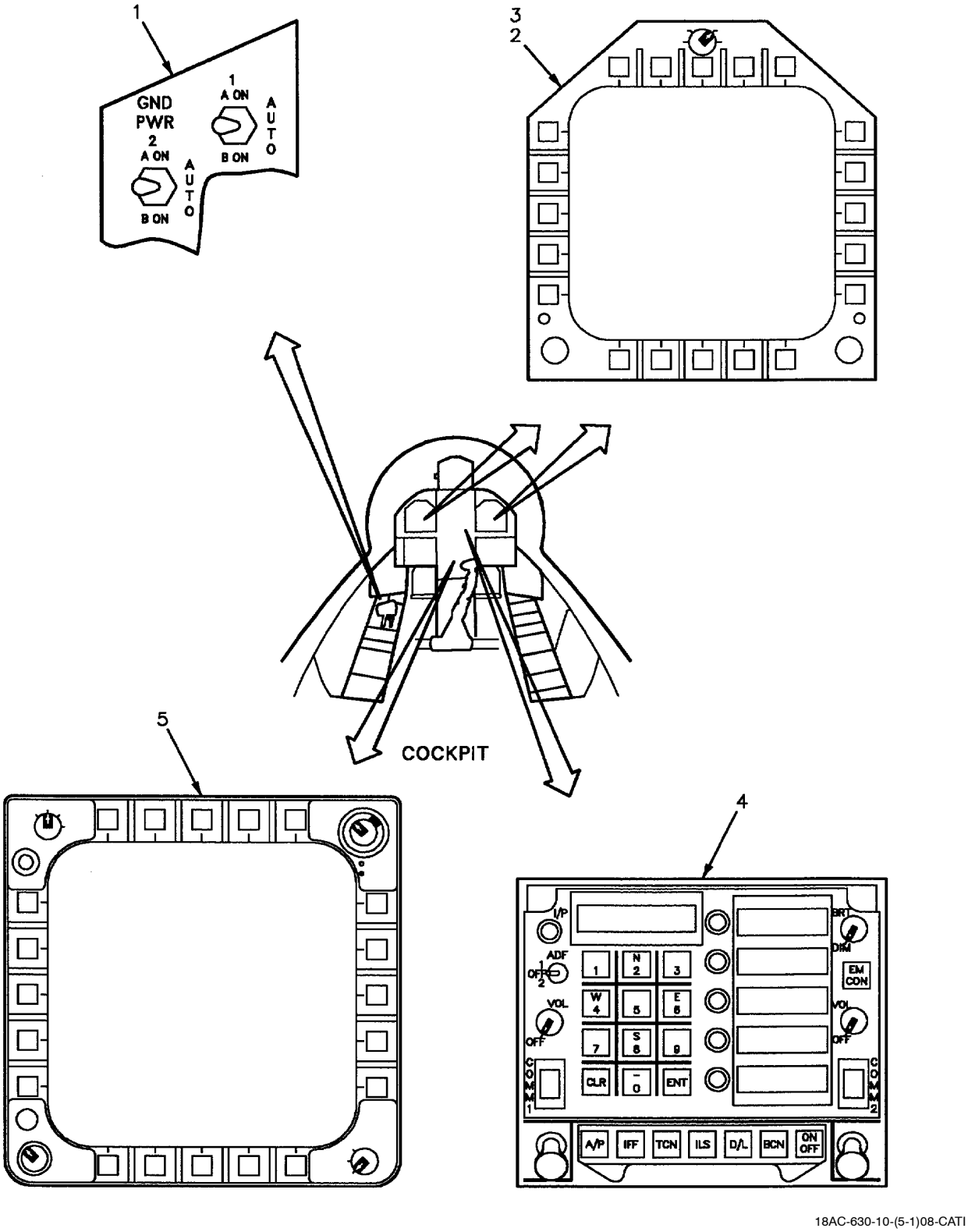


Figure 1. Radar Beacon System Locator (Sheet 1)

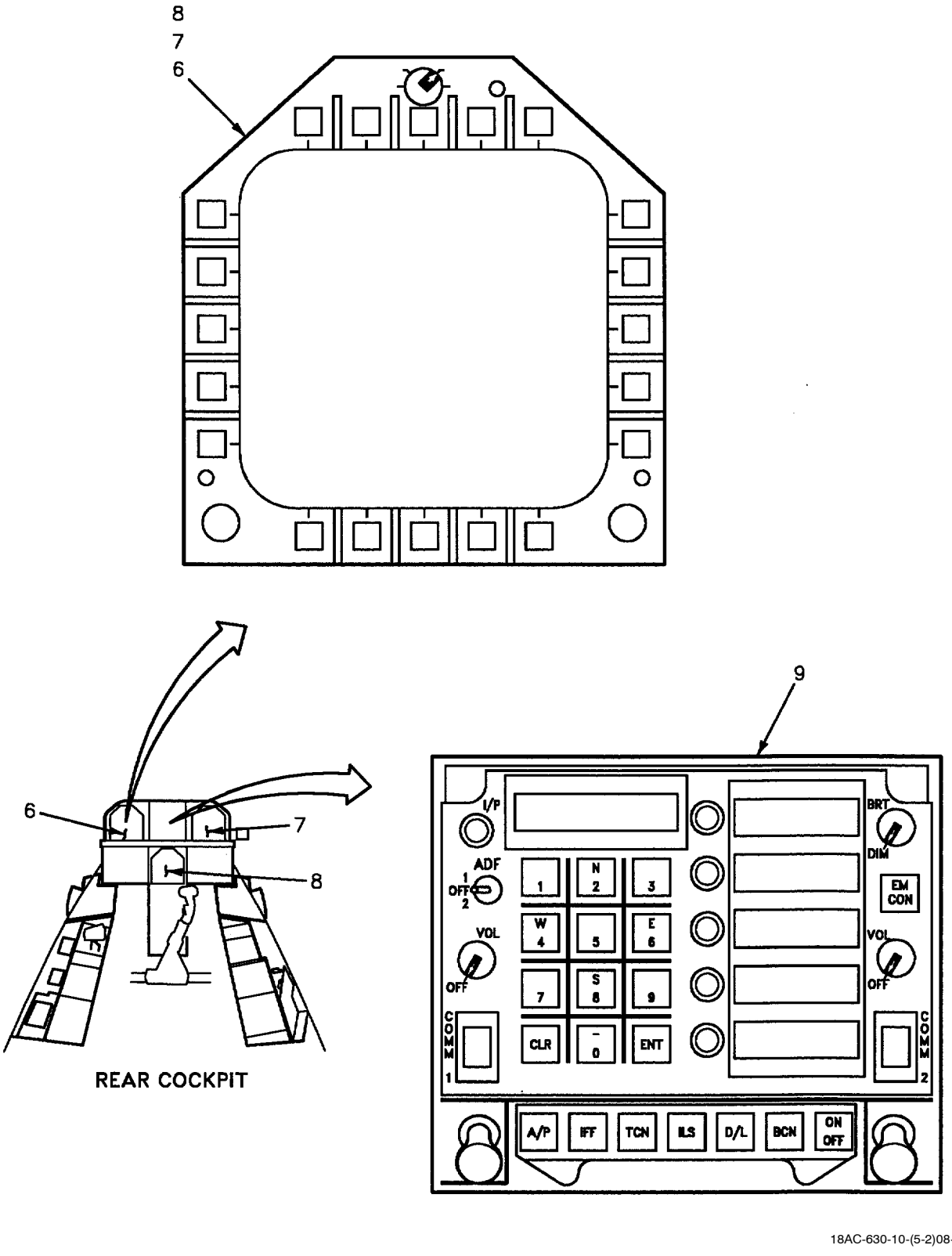


Figure 1. Radar Beacon System Locator (Sheet 2)

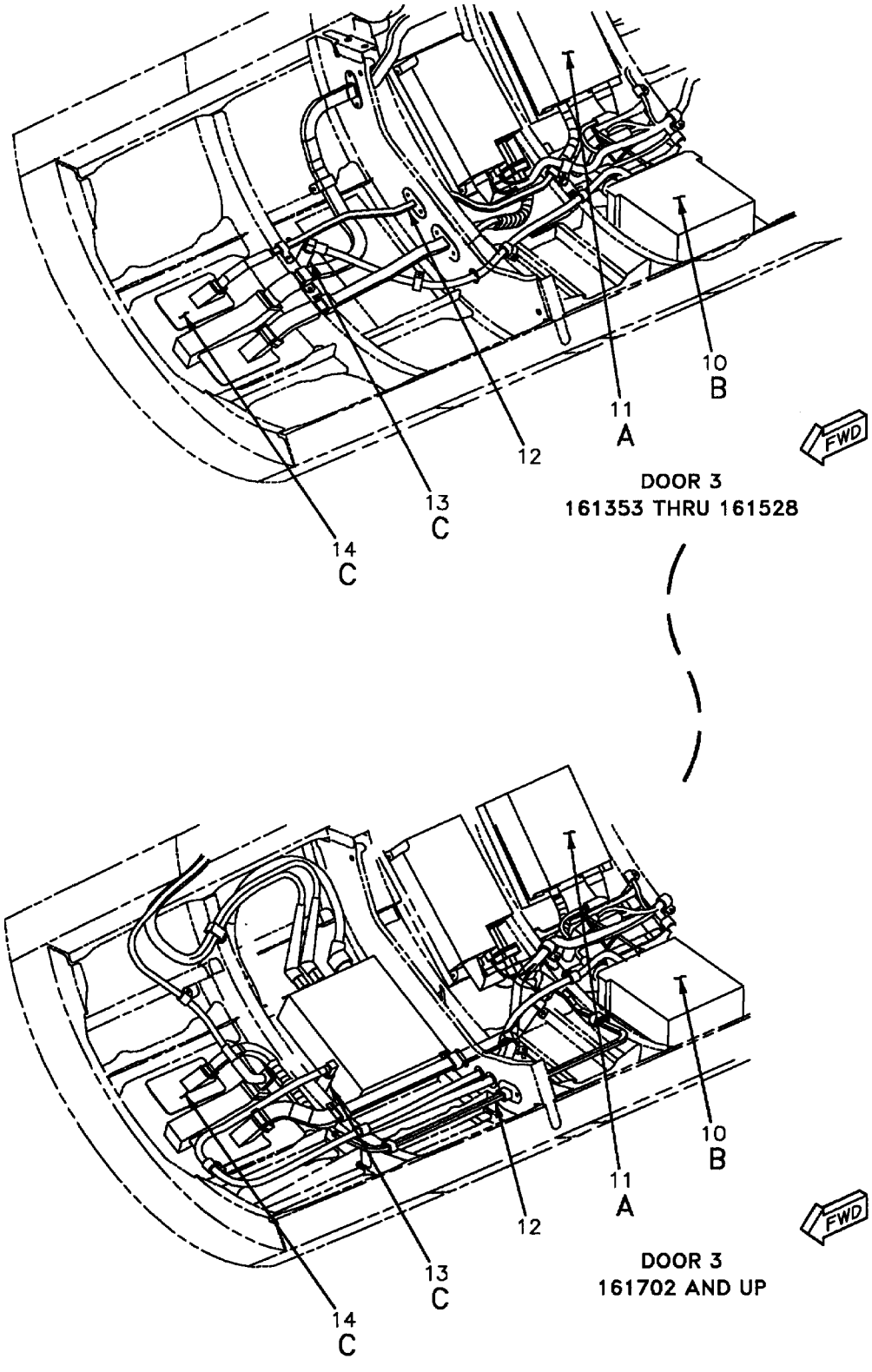
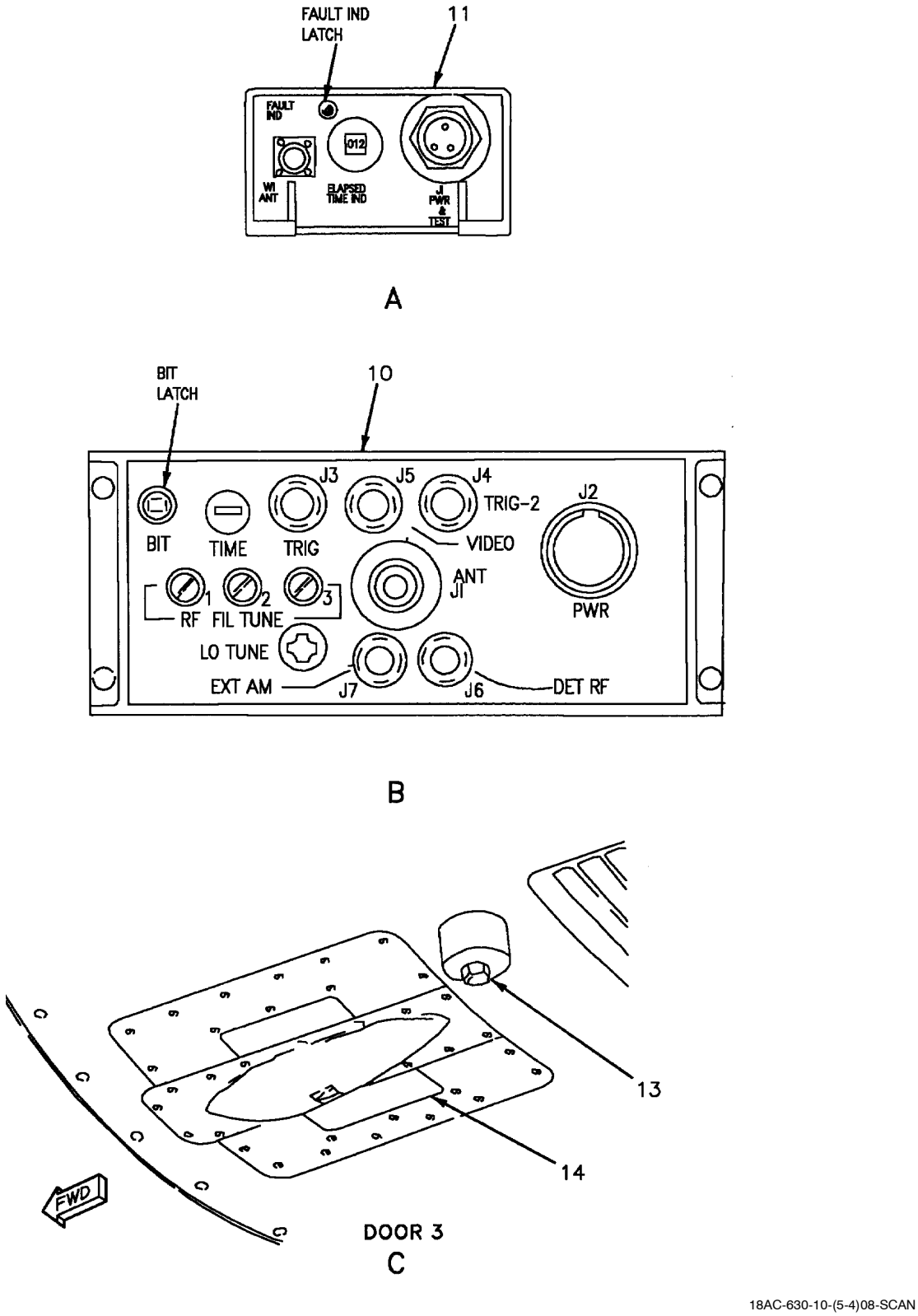


Figure 1. Radar Beacon System Locator (Sheet 3)



18AC-630-10-(5-4)08-SCAN

Figure 1. Radar Beacon System Locator (Sheet 4)

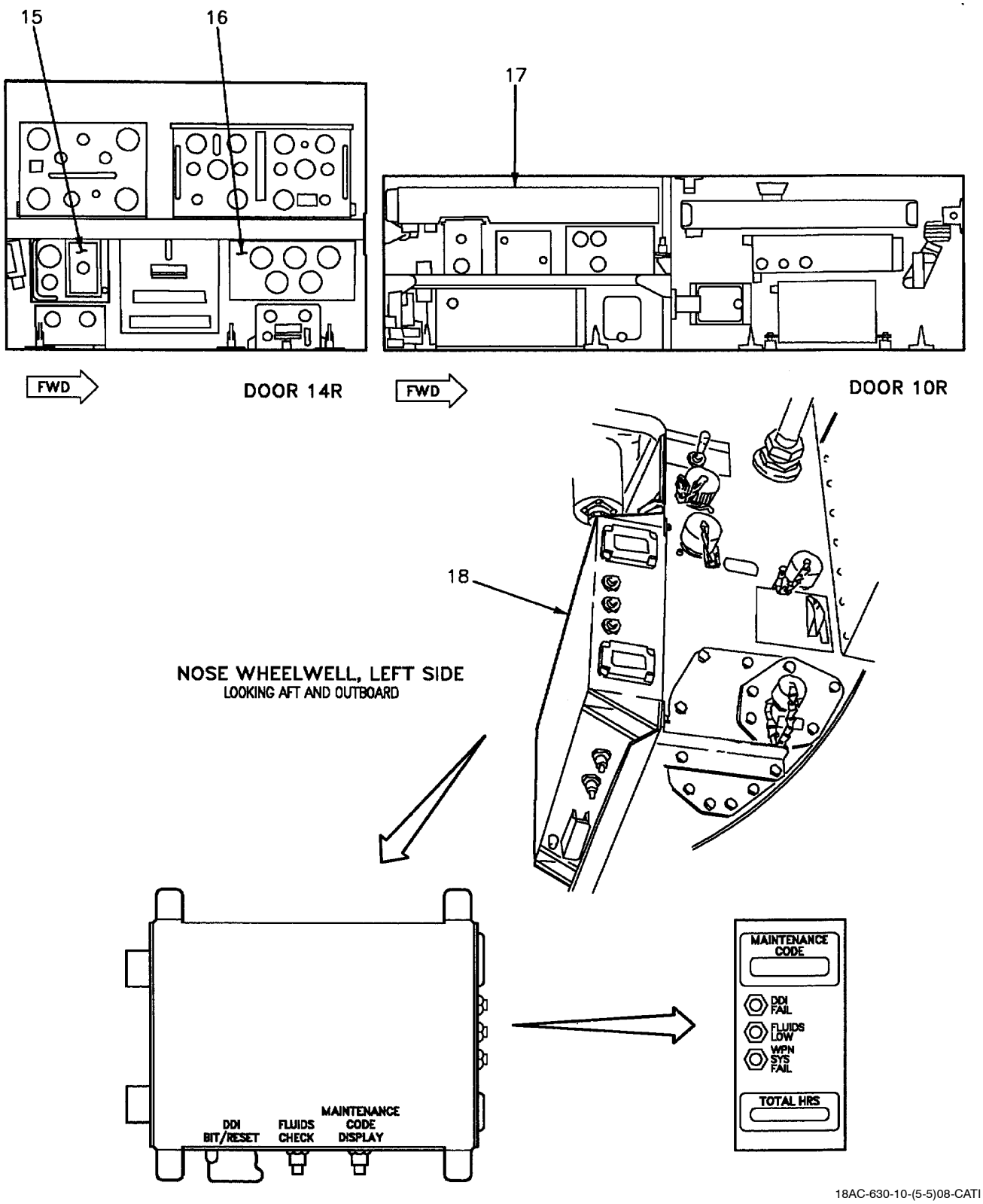


Figure 1. Radar Beacon System Locator (Sheet 5)

NOMENCLATURE	INDEX NO.	REF DES
ELECTRONIC EQUIPMENT CONTROL	4	79A-J006
GROUND POWER CONTROL PANEL ASSEMBLY	1	1A-H004
HORIZONTAL INDICATOR	6	80A-J003
KA-BAND ANTENNA	14	72E-B003
KA-BAND COAX/WAVEGUIDE ASSEMBLY	12	73W-B501
LEFT DIGITAL DISPLAY INDICATOR	2	80A-H001
NOSE WHEELWELL DIGITAL DISPLAY INDICATOR	18	85A-G003
NO. 2 RELAY PANEL ASSEMBLY	16	52A-F058
AUG RECEIVER ON RELAY		72K-F006
BEACON ON RELAY		72K-F005
NO. 4 CIRCUIT BREAKER PANEL ASSEMBLY	17	52A-D026
[1] BEACON R/T AUG (C14)		72CBD007
[2] BCN R/T AGMT (C1)		72CBD007
RADAR BEACON RECEIVER-TRANSMITTER	10	72A-A002
RADAR RECEIVER AUGMENTOR	11	72REB001
REAR CENTER DIGITAL DISPLAY INDICATOR	8	80A-L016
REAR ELECTRONIC EQUIPMENT CONTROL	9	76A-L028
REAR LEFT DIGITAL DISPLAY INDICATOR	6	80A-K019
REAR RIGHT DIGITAL DISPLAY INDICATOR	7	80A-L017
RIGHT DIGITAL DISPLAY INDICATOR	3	80A-J002
SIGNAL DATA RECORDER	15	85A-F001
X-BAND ANTENNA	13	72E-B004

LEGEND

[1] 161353 THRU 161359
[2] 161360 AND UP

Figure 1. Radar Beacon System Locator (Sheet 6)

ORGANIZATIONAL MAINTENANCE

PRINCIPLES OF OPERATION

OPERATION - SEQUENCE OF

RADAR BEACON SYSTEM

This WP supersedes WP0010 00, dated 1 May 1986.

Reference Material

Alphabetical Index

Record of Applicable Technical Directives

None

1. INTRODUCTION.

2. Radar beacon system operation is divided into sequence of operation and functional operation. Sequence of operation is contained in this WP. If functional operation is required, refer to WP011 00.

3. SEQUENCE OF OPERATION.

4. The radar beacon system sequence of operation is divided into the discussions below:

a. power application and mode selection

b. ACL mode

c. STBY mode

d. NORM mode

e. automatic mode selection

f. built-in test

g. emission control mode

For locator, refer to WP009 00.

5. **POWER APPLICATION AND MODE SELECTION.** The electronic equipment control (equipment control) controls power to the radar beacon system. To turn on the system, press the BCN function select switch (figure 1) then the ON/OFF switch. ON appears in the scratch pad display and four mode options appear in the option displays. The radar beacon system is placed in STBY mode on application of power when ACL mode is not selected. Pressing an option select switch selects a different mode and the colon appears next to that mode. The mode options appear for 30 seconds and then the equipment control blanks all displays. To reselect the mode option display, press the BCN function select switch. When ACL mode is selected from the HSI display, power is applied to the radar beacon and the radar beacon is placed in ACL mode of operation. To turn the system off, press the BCN function select switch and then the ON/OFF switch. The scratch pad display and the option display go blank.

6. The mode options for the radar beacon system are:

a. ACL (automatic carrier landing mode)

b. STBY (standby mode)

c. NORM (normal mode)

d. XDAT (external data mode) - not used

7. **ACL MODE.** Pressing the ACL option select switch on the equipment control mode option display (figure 1) causes a colon to appear next to ACL. When the colon appears next to ACL, the radar beacon system is operating in the ACL mode.

8. **STBY MODE.** Pressing the STBY option select switch on the equipment control mode option display (figure 1) causes a colon to appear next to STBY. When the colon appears next to STBY, the radar beacon system is operating in the STBY mode.

9. **NORM MODE.** Pressing the NORM option select switch on the equipment control mode option display (figure 1) causes a colon to appear next to NORM. When the colon appears next to NORM, the radar beacon system is operating in the NORM mode.

10. When operating in the NORM mode, the E(X)D(Y) option select switch on the mode option display selects the encode and decode option display (figure 2). When pressed, an encode/decode option display appears on the equipment control option display. The encode/decode option displays are:

a. ESGL

b. EDBL

c. DSGL

d. DDBL

11. To select single-pulse encoding, press the ESGL option select switch. The encode/decode option display changes to the mode option display. An S appears in the “X” window of the E(X)D(Y) option display.

12. To select double-pulse encoding, press the EDBL option select switch. The encode/decode option display changes to an EDBL/DDBL code option display, displaying five double-pulse encode codes. The double-pulse encode options are:

a. 1

b. 2

c. 3

d. 4

e. 5

When one of the five EDBL codes is selected, the EDBL/DDBL code option display changes to the mode option display. The EDBL code selected appears in the “X” window of the E(X)D(Y) option display.

13. To select single-pulse decoding, press the DSGL option select switch on the encode/decode option display. The encode/decode option display changes to the mode option display. An S appears in the “Y” window of the E(X)D(Y) option display.

14. To select double-pulse decoding, press the DDBL option select switch on the encode/decode option display. The display changes to an EDBL/DDBL option display, displaying five double-pulse decode codes. The double-pulse decode options are:

a. 1

b. 2

c. 3

d. 4

e. 5

When one of the five DDBL codes is selected, the EDBL/DDBL code option display changes to the mode option display. The DDBL code selected appears in the "Y" window of the E(X)D(Y) option.

15. **AUTOMATIC MODE SELECTION.** Automatic mode selection occurs when the radar beacon is turned on by the Digital Data Computer No. 1 (digital computer). This happens when the data link system is operating in the ACL mode. The digital computer can select the modes listed below:

a. ACL

b. STBY

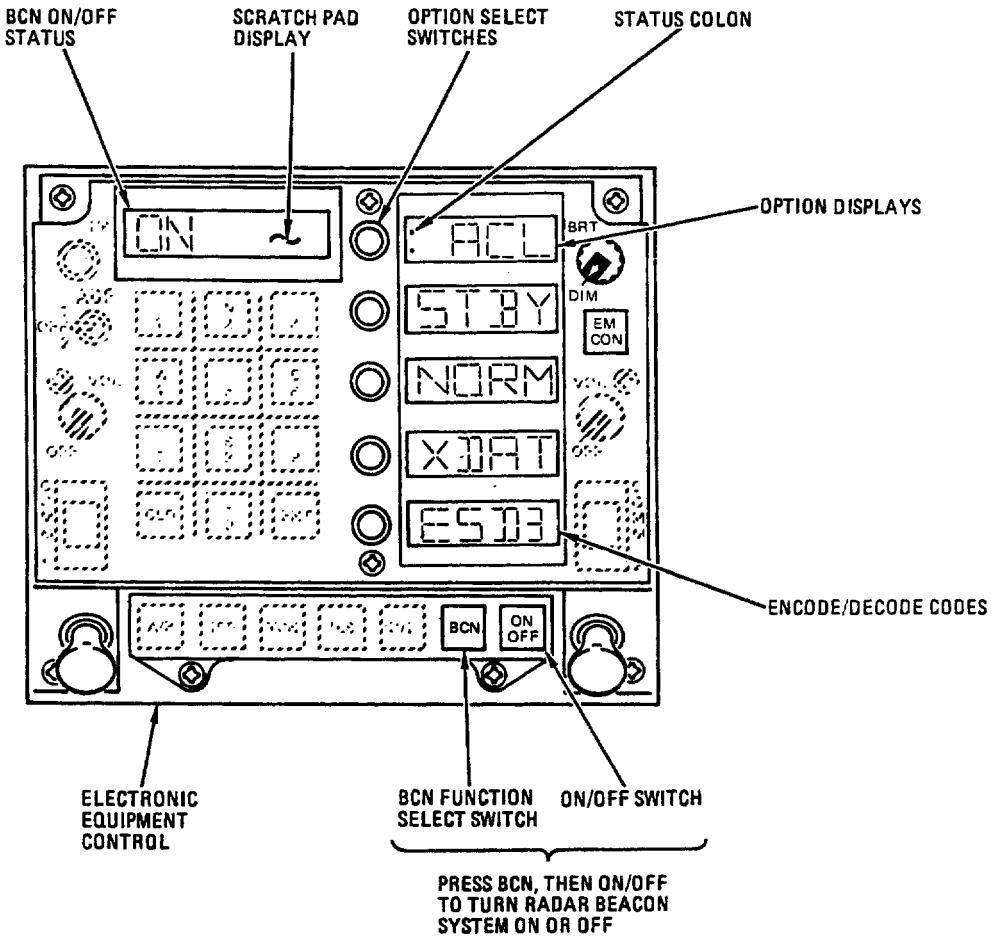
16. When the aircraft is operating in the navigation master mode, selecting ACL on the HSI display sets the radar beacon system in the ACL mode. If the radar beacon is off when ACL is selected on the HSI display, the digital computer turns on the system and sets it in the STBY mode.

17. **BUILT-IN TEST.** Initiated built-in test (BIT) of the radar beacon is done manually. No BIT is done in the STBY mode.

18. **Manually Initiated Bit.** To manually start BIT, press the ILS/AUG/BCN/D/L pushbutton switch (figure 3) on the left or right digital display indicator. The AUG and BCN BIT status on the BIT control display is GO if BIT passes and DEGD if BIT fails.

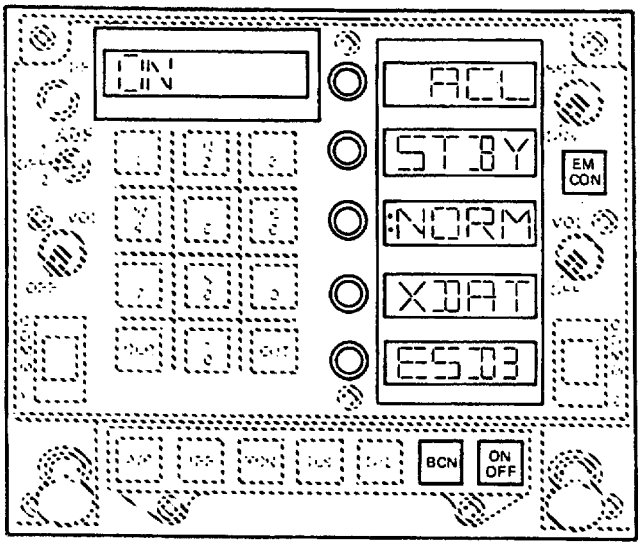
19. If BIT fails, the advisory line on the left or right display indicator displays ADV-BIT. The advisory line is blank if BIT passes. To observe the radar beacon BIT status, press the BIT pushbutton switch on the left or right digital display indicator. The AUG and BCN BIT status is GO if BIT passes and DEGD if BIT fails.

20. **EMISSION CONTROL MODE.** To prevent the radar beacon from transmitting, press the EMCON switch (figure 4) on the equipment control. The equipment control displays an emission control display. To return the radar beacon to operation, press the EMCON switch again. The equipment control then displays the initial radar beacon display.



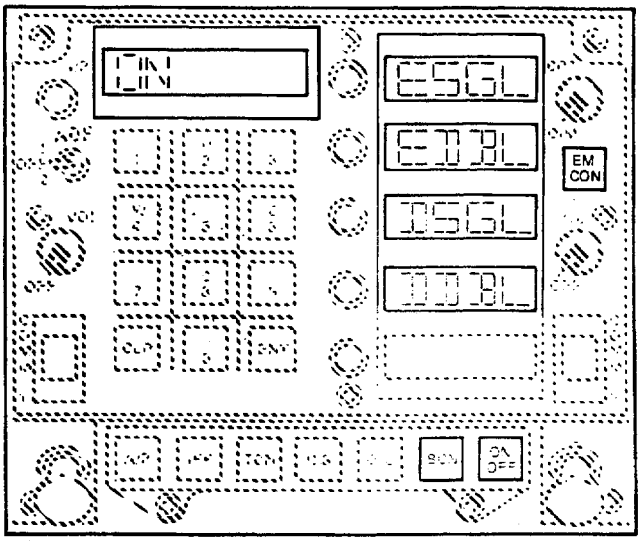
18AC-630-10-(13)A

Figure 1. Power Application and Mode Selection



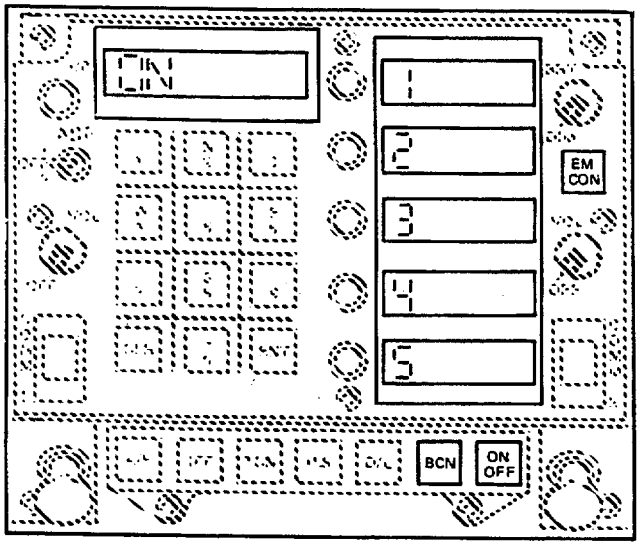
MODE OPTION DISPLAY

DISPLAYS MODES AVAILABLE TO RADAR BEACON SYSTEM. DISPLAYED WHEN BCN FUNCTION SELECT SWITCH IS PRESSED. A COLON APPEARS BESIDE THE MODE SELECTED. THE LAST OPTION DISPLAYS THE ENCODE AND DECODE CODES BEING USED. IN THIS EXAMPLE, ENCODE SIGNAL AND DECODE DOUBLE 3. WHEN PRESSED, THE DISPLAY CHANGES TO ENCODE/DECODE DISPLAY.



ENCODE/DECODE OPTION DISPLAY

DISPLAYS ENCODE/DECODE OPTIONS WHEN OPTION 5 SELECTED ON MODE OPTION DISPLAY. IF ESGL OR DSGL SELECTED ON ENCODE/ DECODE OPTION DISPLAY, DISPLAY CHANGES TO MODE OPTION WITH AN S DISPLAYED ON OPTION 5. IF EDBL OR DDBL SELECTED ON ENCODE/ DECODE OPTION DISPLAY, DISPLAY CHANGES TO EDBL/ DDBL CODE OPTION DISPLAY.



EDBL/DDBL CODE OPTION DISPLAY

DISPLAYS CODES AVAILABLE FOR ENCODING AND DECODING WHEN EDBL OR DDBL SELECTED ON ENCODE/DECODE DISPLAY. WHEN ONE OF FIVE COPIES IS SELECTED, EDBL/DDBL CODE OPTION DISPLAY CHANGES TO MODE OPTION DISPLAY, WITH THE CODE DISPLAYED IN OPTION 5.

18AC-630-10-(17)A

Figure 2. Encode and Decode Code Selection

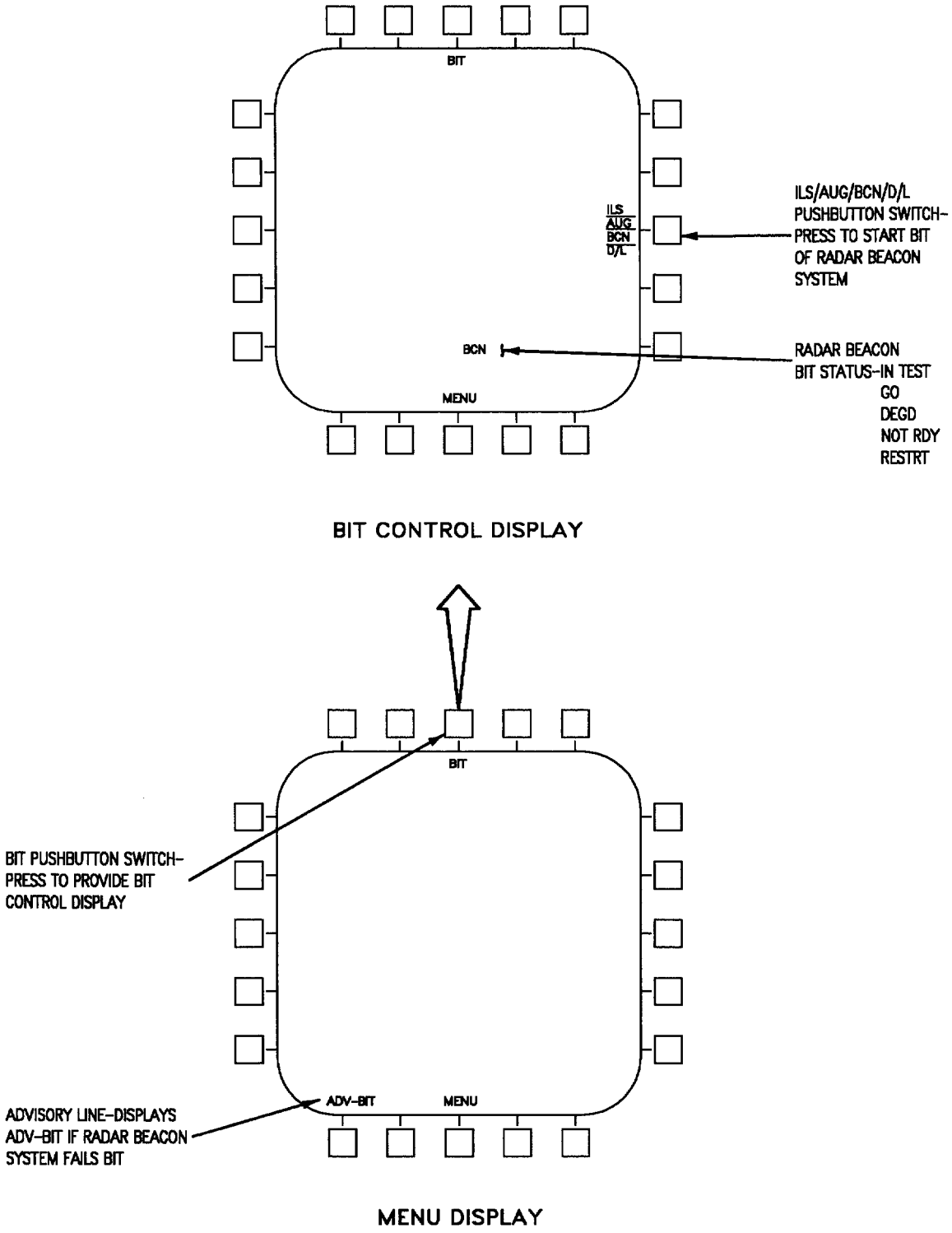
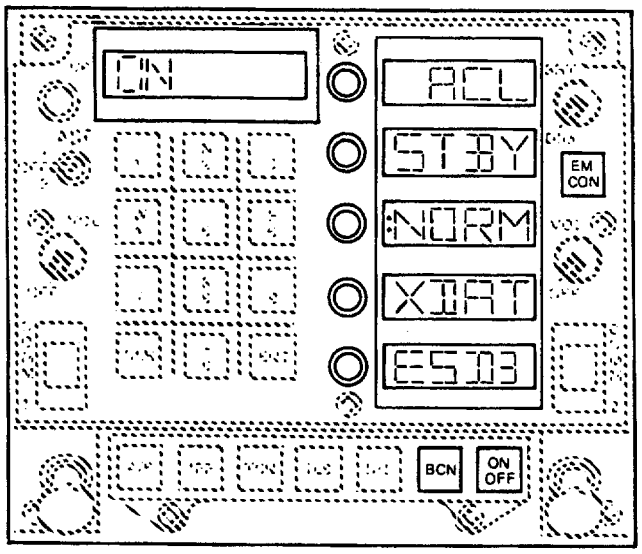
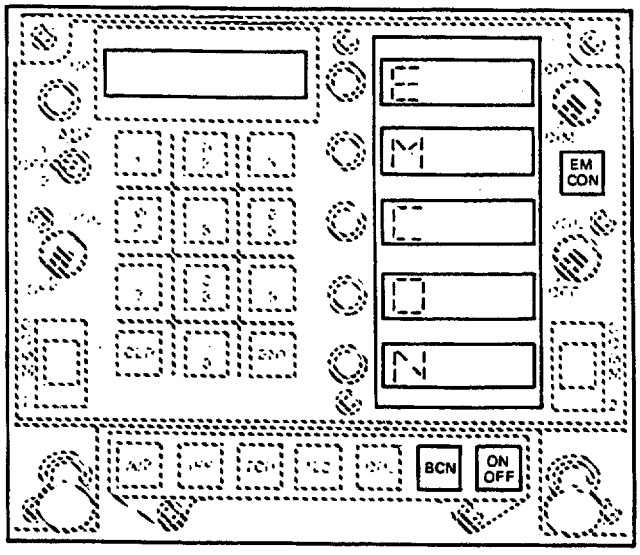


Figure 3. Manually Initiated BIT



RADAR BEACON DISPLAY

IF EMCON IS SELECTED ON EQUIPMENT CONTROL, DISPLAY CHANGES TO EMISSION CONTROL DISPLAY, PREVENTING THE RADAR BEACON FROM TRANSMITTING



EMISSION CONTROL DISPLAY

DISPLAYED WHEN EMCON SELECTED ON EQUIPMENT CONTROL. TO DESELECT EMCON, PRESS THE EMCON SWITCH AGAIN. DISPLAY CHANGES TO RADAR BEACON DISPLAY. RADAR BEACON RETURNS TO NORMAL OPERATION.

18AC-630-10-(16)A

Figure 4. Emission Control Mode

ORGANIZATIONAL MAINTENANCE

PRINCIPLES OF OPERATION

OPERATION - FUNCTIONAL

RADAR BEACON SYSTEM

Reference Material

Alphabetical Index

Record of Applicable Technical Directives

None

1. INTRODUCTION.

2. The Radar Beacon System AN/APN-202 (radar beacon) improves the tracking capabilities of surface radar and the automatic carrier landing system (ACLS). Discussions of the radar beacon operation are:

a. power application

b. mode selection

c. code selection

d. ACL mode

e. NORM mode

f. STBY mode

g. emission control mode

h. built-in test modes

Refer to Radar Beacon System Simplified Schematic, figure 1, WP012 00. WP010 00 contains the sequence of operation for the radar beacon system. For locator, refer to WP009 00.

3. POWER APPLICATION.

4. With ground power applied, GND PWR control panel assembly 2 switch must be set to B ON. This sends 28vdc to the coil of the beacon on relay (72K-F005) and aug receiver on relay (72K-F006). These relays control power to the radar beacon system. They can be energized manually or automatically and depend upon the mode of operation selected. During the NORM and STBY modes, only the beacon on relay is energized. During the ACL mode, both relays are energized.

5. If ground power is removed while the radar beacon is on and weight is on wheels, the control-converter removes the ground signals from the radar beacon power relays. The radar beacon stays off until ground power is applied again, and is turned on by the equipment control.

6. If weight is off wheels and power is lost, the control-converter removes the ground signals from the radar beacon power relays. The control-converter sends the ground signals back to the relays when power comes back on.

7. **MANUAL POWER APPLICATION.** The beacon on and aug receiver on relays are manually activated by the Electronic Equipment Control C-10380/ASQ (equipment control). ON is displayed on the scratch pad display when the radar beacon system is on. The beacon on relay is activated when the BCN function select switch, then the ON/OFF switch is pressed. On application of power, the radar beacon is placed in STBY operation when ACL mode is not selected from the HSI display. The Control-Converter C-10382/A (control-converter) is commanded to send a bcn on (ground) signal to energize the beacon on relay. When energized, 28vdc is sent to the power supply of the Radar Receiver-Transmitter RT-1028/APN-202 (receiver-transmitter).

8. Both relays are activated in the ACL mode when the BCN function select switch, then the ON/OFF switch is pressed. The control-converter is commanded to send a bcn go (ground) signal to the beacon on relay and an aug rcvr on (ground) signal to the aug receiver on relay. When energized, 28vdc is sent to the power supplies of the Radar Receiver R-1623/APN (receiver) and receiver-transmitter.

9. When operating in the ACL mode and the STBY mode is selected or the EMCON switch is pressed, power is removed from the receiver. The control-converter is commanded to remove the aug rcvr on (ground) signal from the aug receiver on relay. When deenergized, 28vdc is removed from the receiver power supply.

10. **AUTOMATIC POWER APPLICATION.** The beacon on and aug receiver on relays are automatically energized by Digital Data Computer No. 1 (digital computer) when the data link system is operating in the ACL mode. This occurs when the aircraft is in the navigation master mode, and ACL is selected on HSI display. The digital computer sends a radar beacon status command tells the control-converter to receive the radar beacon on and radar beacon STBY signals. The control-converter uses these signals to produce a bcn on (ground) and on aug rcvr on (ground) signal.

11. The control-converter sends the bcn and aug rcvr on signals to the no. 2 relay panel assembly beacon on (72K-F005) and aug receiver on (72K-F006) relays. This sends 28vdc to the power supplies of the receiver and receiver-transmitter.

12. The digital computer also monitors a radar beacon on signal from the control-converter. If this signal does not exist (radar beacon is off), the digital computer sends a radar beacon status command, a radar beacon on, and a radar beacon standby signal to the control-converter.

13. The control-converter uses these signals to produce a bcn on (ground) signal. The bcn on signal is sent to the beacon on relay (72K-F005) in the no. 2 relay panel assembly. This sends 28vdc to the power supply of the receiver-transmitter. The control-converter also sends a stby mode signal to the receiver-transmitter. This allows the receiver-transmitter to warmup but prevents it from transmitting.

14. MODE SELECTION.

15. The radar beacon modes of operation are selected manually or automatically. The equipment control is used to manually select the modes of operation. Modes are automatically selected by the digital computer when the data link system is operating in the ACL mode.

16. **MANUAL MODE SELECTION.** The equipment control option select switches manually select the mode of operation. The option select switches tell the control-converter which mode has been selected. The option display displays a colon beside the option selected to tell which option is selected.

17. The control-converter selects the NORM mode when the BCN function select, ON/OFF, and NORM option select switches are pressed. The control-converter stores NORM in memory and turns on the receiver-transmitter. The control-converter sends a stby mode signal to the receiver-transmitter for 30 seconds. The receiver-transmitter is inhibited from transmitting until warmup. After 30 seconds, the stby mode signal is removed and the radar beacon operates in the NORM mode.

18. The control-converter selects the ACL mode when the BCN function select, ON/OFF, and ACL option select switches are pressed. The control-converter stores ACL in memory and turns on the receiver and receiver-transmitter. A stby mode signal is sent to the receiver-transmitter, inhibiting response to X-band interrogation radar signals.

19. The control-converter selects the STBY mode when the BCN function select, ON/OFF, and STBY option select switches are pressed. STBY mode is also selected when not in ACL mode and BCN and ON/OFF function select switches are selected. The control-converter stores STBY in memory and turns on the receiver-transmitter. The control-converter sends a stby mode signal to the receiver-transmitter inhibiting transmission. When the radar beacon is operating in ACL and STBY is selected, the control-converter turns the receiver off. The control-converter turns off the receiver by removing the aug rcvr on signal from the receiver.

20. The control-converter selects the EMCON mode when the EMCON switch is pressed. The equipment control displays EMCON on the option displays and the control-converter sends a stby mode signal to the receiver-transmitter. The stby mode signal inhibits transmission by the radar beacon. If the radar beacon was operating in the ACL mode when EMCON is selected, the control-converter turns off the receiver by removing the aug rcvr on signal. The radar beacon returns to the initial mode of operation when the EMCON switch is pressed again. The option display changes from EMCON to the initial display.

21. **AUTOMATIC MODE SELECTION.** Modes of operation are automatically selected by the digital computer when the data link system is operating in the ACL mode. When the aircraft is in the navigation master mode, the digital computer tells the radar beacon to operate in the ACL mode when ACL is selected on a HSI display. The digital computer sends a radar beacon status command, radar beacon on, and radar beacon ACL signal to the control-converter. The radar beacon status command tells the control-converter to receive the radar beacon on, and radar beacon ACL signals.

22. ACL is stored in the control-converter mode memory. The control-converter sends a bcn on signal to the receiver-transmitter and an aug rcvr on signal to the receiver. The stby mode signal is sent to the receiver-transmitter, preventing it from responding to X-band interrogation radar signals. If the BCN function select switch is pressed on the equipment control, a colon is displayed next to the ACL option. The radar beacon is now operating in ACL.

23. The control-converter also sends a radar beacon on signal to the digital computer. If this signal does not exist (radar beacon is off), the digital computer sends a radar beacon status command, radar beacon on, and radar beacon STBY signal to the control-converter. The radar beacon status command tells control-converter to receive the radar beacon on and radar beacon STBY signals.

24. The control-converter produces a bcn on and stby mode signal. The bcn on signal turns on the receiver-transmitter and the stby mode signal puts the receiver-transmitter in the STBY mode. If the BCN function select switch is pressed on the equipment control, a colon is displayed next to the STBY option.

25. CODE SELECTION.

26. Radar beacon encode and decode codes are selected in the NORM and ACL modes. The radar beacon decodes signals being received and encodes signals being transmitted. The radar beacon automatically encodes and decodes signals in the ACL mode. The last option select switch on the equipment control selects the encode and decode code in the NORM mode.

27. The four encode/decode options listed below are displayed on the option displays when the last option select switch is pressed:

a. ESGL

b. EDBL

c. DSGL

d. DDBL

28. A “S” is displayed in the last mode option display when ESGL or DSGL is selected. Five encode/decode double codes are displayed on the option display when the EDBL or DDBL option select switches are pressed. They are:

a. 1

b. 2

c. 3

d. 4

e. 5

29. The encode/decode double code selected is displayed in the last mode option display. The encode/decode code selected is stored in the control-converter memory, converted to digital, and sent to the receiver-transmitter. The receiver-transmitter sends a 20vdc reference signal to the control-converter. The control-converter uses this reference voltage to produce the encode/decode code voltages.

30. The radar beacon automatically encodes and decodes single pulses in the ACL mode. Codes entered on the equipment control do not affect the radar beacon during ACL. The digital computer also has no affect on the encode/decode code when the radar beacon is automatically turned on by the digital computer.

31. ACL MODE.

32. The KA-band input to the receiver is made up of pulsed interrogations received from a conically-scanning surface radar. An aircraft centered within the conical scan does not produce amplitude variations in the received KA-band signals. Aircraft not centered within the conical scan produce amplitude variations in the received signals. The amplitude variations are called spin error and occur at the 100 Hz conical scan rate of the surface radar antenna.

33. The KA-band rf inputs to the receiver are sent to the attenuator, where the amount of signal attenuation is controlled by an AGC voltage from the AGC circuit. The attenuated KA-band signal output is detected by the detector and supplied as video to the video amplifier for amplification. Amplification of the

video signals is controlled by an AGC voltage input from the AGC circuit. The amplification is linear for low-level signals and compressed for high-level signals. This method of amplification allows variation in input signal amplitudes with negligible effects on the spin error modulation (if any) included in the video signals. The amplified video output of the video amplifier is sent to the AGC circuit.

34. The amplitude envelope (spin error) of the video signals from the video amplifier is detected in the AGC circuit. There, the peak value of the video signals is used to produce AGC voltages for the attenuator and video amplifier. The AGC circuit also produces a spin error signal that is sent to the circulator of the receiver-transmitter. A video pulse output is also sent to the delay stabilizer of the receiver.

35. The video pulse from the AGC circuit and a detected rf pulse input from the receiver-transmitter rf detector are time compared in the delay stabilizer to produce an ACL trigger signal for the receiver-transmitter. This results in a 1.5 microsecond delay from KA-band input to X-band output. Accuracy of the 1.5 microsecond delay is maintained by the receiver reference delay line. The purpose of the 1.5 microsecond delay is to provide a timing reference so that surface radar can compensate for the system delay.

36. The video pulse is sent to the reference delay line while being initially delayed 1.8 to 2 microseconds. It is then sent as an ACL trigger to the modulator trigger control in the receiver- transmitter. The receiver-transmitter accepts the ACL trigger pulse and processes it for transmission. Just before transmission, the video pulse is detected and sent to the receiver delay stabilizer for comparison. The input video, the detected rf and the video returned by the reference delay line are compared for a stabilized 1.5 microsecond delay. If a stabilized 1.5 microsecond delay has not occurred, the delay stabilizer corrects the 1.8 to 2 microsecond delay to the desired 1.5 microsecond delay and produces another ACL trigger. This action continues until there is a 1.5 microsecond delay between the KA-band input signal and the X-band output signal.

37. The delay stabilizer then senses the presence of a correct 1.5 microsecond delay and produces an ACL go/interrogate signal for the control-converter. During BIT, this signal represents a receiver go condition.

38. The receiver-transmitter STBY mode line is activated during the ACL mode, causing the decoder to be inhibited. All receiving functions are then disabled, unable to respond to X-band interrogations. Since there are no decoder output pulses, the encoder is also disabled. This leaves the modulator trigger control to be triggered by the ACL trigger signal from the receiver.

39. When triggered, the modulation trigger control produces a single pulse (encode single) and sends it to the beacon delay normalizer where circuit delays are normalized to 1 microsecond. The normalized pulse is then sent to the overinterrogation control and the blanking gate. The overinterrogation control keeps the radar beacon from exceeding the reply rate limitations as a result of abnormally high interrogation rates. The overinterrogation control monitors beacon delay normalizer and power amplifier outputs and sends an overinterrogation blanking pulse to the blanking gate when the reply rate exceeds limitations.

40. The blanking gate controls the time that triggers are accepted by the transmitter. Normally, triggers from the beacon delay normalizer are passed through the blanking gate. However, if an overinterrogation condition exists, an overinterrogation blanking pulse is applied to the blanking gate, inhibiting transmission of pulses for about 50 microseconds.

41. Trigger pulses from the blanking gate are sent to the modulator pulse former. The modulator pulse former produces an output pulse that controls. the width of the transmitted rf pulse. The output pulse is sent to Interference Blanker MX-9965/A, blanking out Radar Set AN/APG-65, Command Launch Computer CP-1001/AWG, and Countermeasures Set AN/ALQ-126 while the radar beacon is transmitting. If output pulses from the modulator pulse former are spaced too close, the blanking pulse generator triggers the blanking gate, preventing transmission by the radar beacon.

42. The trigger pulses are amplified by the pulse amplifier and power amplifier and sent to the overinterrogation control and modulation transformer. The overinterrogation control monitors the reply rate of the output pulses. The modulation transformer produces a high-voltage output modulator pulse and sends it to the magnetron.

43. When triggered by the modulation transformer output, the magnetron produces an rf output pulse in the X-band and sends it to the circulator. Spin error from the receiver modulates the output pulses as they are being transmitted by the X-band antenna. An rf detector monitors the magnetron output, sending detected rf pulses to the receiver delay stabilizer for timing purposes.

44. NORM MODE.

45. The receiver-transmitter receives single pulse or coded double-pulse X-band interrogations from surface-based radars and responds with single pulse or coded double-pulse replies at an offset frequency in the X-band. X-band interrogations received by the antenna are directed by the circulator to the tunable three-cavity coaxial preselector which attenuates any signals outside of the receiver-transmitter bandpass. The remaining signal is coupled to the mixer.

46. The local oscillator outputs a frequency which is adjustable between 8.5 and 9.5 GHz. The oscillator and input signals are heterodyned in the mixer to produce a 60 MHz IF output to the low noise amplifier. The low noise amplifier has an alternate 60 MHz IF input during BIT. When the BCN BIT enable signal exists, the BIT circuitry produces a 60 MHz BIT IF signal. The input during BIT is processed just like an input interrogation signal received by the antenna. The low noise amplifier, along with the IF amplifier, amplifies the 60 MHz IF signal and sends it to the detector. The detector controls the input level and provides a linear trigger output to the decoder.

47. Trigger output pulses from the detector are sent to the decoder. The decoder uses the decode control and BCN decode sgl/dbl inputs to select the decode code. The selected decode code is compared with the trigger output. If the selected decode code matches the signal (trigger output) being sent by surface radar, an output pulse is sent to the modulator trigger control and the encoder. However, if an overinterrogation condition exists, the decoder is inhibited and prevented from receiving X-band interrogations. The decoder is also inhibited when the radar beacon is operating in the ACL or STBY modes.

48. Output pulses from the decoder are sent to the modulator trigger control, producing a single trigger pulse. The decoder also sends an output pulse to the encoder. If encoding double, the encoder produces a delayed output pulse and sends it to the modulator trigger-control, producing a double pulse trigger output. If encoding single, the encoder is inhibited and only one trigger pulse is produced by the modulator trigger control.

49. The encode pulses from the modulator trigger control are sent to the beacon delay normalizer where circuit delays are normalized to 1 microsecond. The normalized pulse is then sent to the overinterrogation control and the blanking gate. The overinterrogation control keeps the radar beacon from exceeding the reply rate limitations as a result of abnormally high interrogation rates. The overinterrogation control monitors beacon delay normalizer and power amplifier outputs and sends an overinterrogation blanking pulse to the blanking gate when the reply rate exceeds limitations.

50. The blanking gate controls the time that triggers are accepted by the transmitter. Normally, triggers from the beacon delay normalizer are passed through the blanking gate. However, if an overinterrogation condition exists, an overinterrogation blanking pulse is sent to the blanking gate, inhibiting transmission of pulses for about 50 microseconds.

51. Trigger pulses from the blanking gate are sent to the modulator pulse former. The modulator pulse former produces an output pulse that controls the width of the transmitted rf pulse. The output pulse is sent to Interference Blanker MX-9965/A, blanking out Radar Set AN/APG-65, Command Launch Computer CP-1001/AWG, and Countermeasures Set AN/ALQ-126 while the radar beacon is transmitting. If output pulses from the modulator pulse former are spaced too close, the blanking

pulse generator triggers the blanking gate, preventing transmission by the radar beacon.

52. The trigger pulses are then amplified by the pulse amplifier and power amplifier and sent to the overinterrogation control and modulation transformer. The overinterrogation control monitors the reply rate of the output pulses. The modulation transformer produces a high-voltage modulator output and sends it to the magnetron.

53. The magnetron, when triggered by the modulation transformer output, produces a rf output pulse in the X-band and sends it to the circulator. The circulator allows use of a common antenna for both transmit and receive functions. When the rf pulse is sent to the circulator, it is directed to the X-band antenna for transmission to surface-based radar.

54. STBY MODE.

55. The control-converter sends a STBY mode signal to the receiver-transmitter in the STBY mode. The STBY mode signal disables the decoder, making the receiver-transmitter unable to respond to X-band interrogations. With no decoder output pulses, the modulator trigger control is unable to send reply triggers to the transmitter.

56. EMISSION CONTROL MODE.

57. The radar beacon operates in the emission control mode when the EMCON switch is pressed on the equipment control. This tells the control-converter to operate the radar beacon in the STBY mode. The equipment control displays EMCON on the option displays. The display disappears and returns to normal when the EMCON switch is pressed again. The radar beacon then returns to normal operation.

58. BUILT-IN TEST.

59. The radar beacon built-in test (BIT) is manually started by pressing the ILS/AUG/BCN/D/L pushbutton switch on the left or right Digital Display Indicator IP-1317( ) (DDI) in the NORM and ACL modes. No BIT is done in the STBY mode. Fault indicators located on the receiver and receiver-transmitter give visual indications of failed units. The fault indicator turns white if a fail occurs during BIT. Normally, the fault indicator is black.

60. The receiver starts BIT when it receives an AUG RCVR BIT enable signal from the control-converter. The AGC circuit in the receiver resets the fault indicator to normal at the start of BIT. The delay stabilizer produces a BIT video signal and sends it to the video amplifier. The video amplifier processes the BIT video as an actual signal. The video signal is sent to the AGC circuit to produce video pulses. The delay stabilizer sets the fault indicator to failed (white) if the video pulses do not exist. Only internal faults such as loss of the ACL trigger, loss of power supply, or a defective delay stabilizer will cause the fault indicator to latch. The receiver sends an ACL go/interrogate signal to the control-converter if BIT passes. During BIT, this signal represents a receiver go condition. During normal operation, this signal indicates that KA-band interrogations are being received.

61. The receiver-transmitter starts BIT when it receives a BCN BIT enable signal from the control-converter. The BIT circuitry resets the fault indicator to normal at the start of BIT. The BIT circuitry then produces a BIT IF signal and sends it to the low noise amplifier. The low noise amplifier blocks any signals being received and processes the 60 MHz BIT IF as a true signal. The BIT circuitry monitors the detected rf output. The BIT circuitry sets the fault indicator to failed if the rf pulses do not exist or are not in synchronization with the 60 MHz BIT IF signal. Only internal failures cause the fault indicator to be set to failed (white). The receiver-transmitter sends a BCN go signal to the control-converter if BIT passes.

62. When the receiver or receiver-transmitter fails BIT, the digital computer sends an AUG or BCN WRA fail signal to the Signal Data Recorder RO-508/ASM-612 (recorder). The recorder converts the fail signals to digital failure codes and sends them to the Digital Display Indicator ID-2150/ASM-612 (digital display indicator). The digital display indicator stores the AUG and BCN failure codes (151 and 153) in memory and displays the code on a digital display.

63. **MANUALLY INITIATED BIT.** The ILS/AUG/BCN/D/L pushbutton switch on the BIT control display of the left or right digital display indicator manually starts radar beacon BIT. The left or right digital display indicator sends on ILS/AUG/BCN/D/L BIT initiate signal to the digital computer. The digital computer uses this signal to produce a BCN and AUG initiated BIT request. The BCN and AUG initiated BIT requests are sent to the control-converter for processing.

64. The control-converter produces a BCN BIT enable signal when a BCN warm and BCN initiated BIT request signal is present. The control-converter sends the BCN BIT enable signal to the receiver-transmitter and tells it to start BIT. The BCN BIT enable signal also causes the control-converter to send a decode single command to the receiver-transmitter. The control-converter also sends a BCN in test signal to the digital computer for 5 seconds. At the end of 5 seconds, the control-converter removes the BCN in test and sends a BCN test complete signal to the digital computer. A BCN WRA fail is also sent if the receiver-transmitter does not send a BCN go signal to the control-converter.

65. The control-converter sends an AUG RCVR BIT enable signal to the receiver when a BCN warm, AUG RCVR warmup complete, and AUG initiated BIT request exists. The control-converter also sends an AUG in test signal to the digital computer for 10 seconds. At the end of 10 seconds, the control-converter removes the AUG in test signal and sends an AUG test complete signal to the digital computer. An AUG WRA fail signal is also sent if the control-converter does not receive an ACL go/interrogate signal from the receiver.

66. The digital computer uses the signals from the control-converter to produce the BCN and AUG BIT status messages. The left or right digital display indicator displays the BIT status messages on the BIT control display. BCN IN TEST is displayed for 5 seconds when BCN in test is received from the control-converter. BCN GO is displayed at the end of 5 seconds when BCN test complete is received and BCN WRA fail does not exist. If BCN WRA fail is present, BCN DEGD is displayed. If the radar beacon is off when BIT is started or the test is not complete in 5 seconds, BCN NOT RDY is displayed for 75 seconds. At the end of 75 seconds, BCN RESTRT is displayed.

67. The left or right digital display indicator displays AUG IN TEST for 10 seconds when the digital computer receives an AUG in test signal from the control-converter. AUG GO is displayed at the end of 10 seconds when AUG test complete is received and AUG WRA fail does not exist. If AUG WRA fail exists, AUG DEGD is displayed. If the radar beacon is off when BIT is started or the test is not complete in 10 seconds, AUG NOT RDY is displayed for 60 seconds. At the end of 60 seconds AUG RESTRT is displayed.

ORGANIZATIONAL MAINTENANCE

PRINCIPLES OF OPERATION

SCHEMATIC - SIMPLIFIED

RADAR BEACON SYSTEM

Reference Material

None

Alphabetical Index

Record of Applicable Technical Directives

None

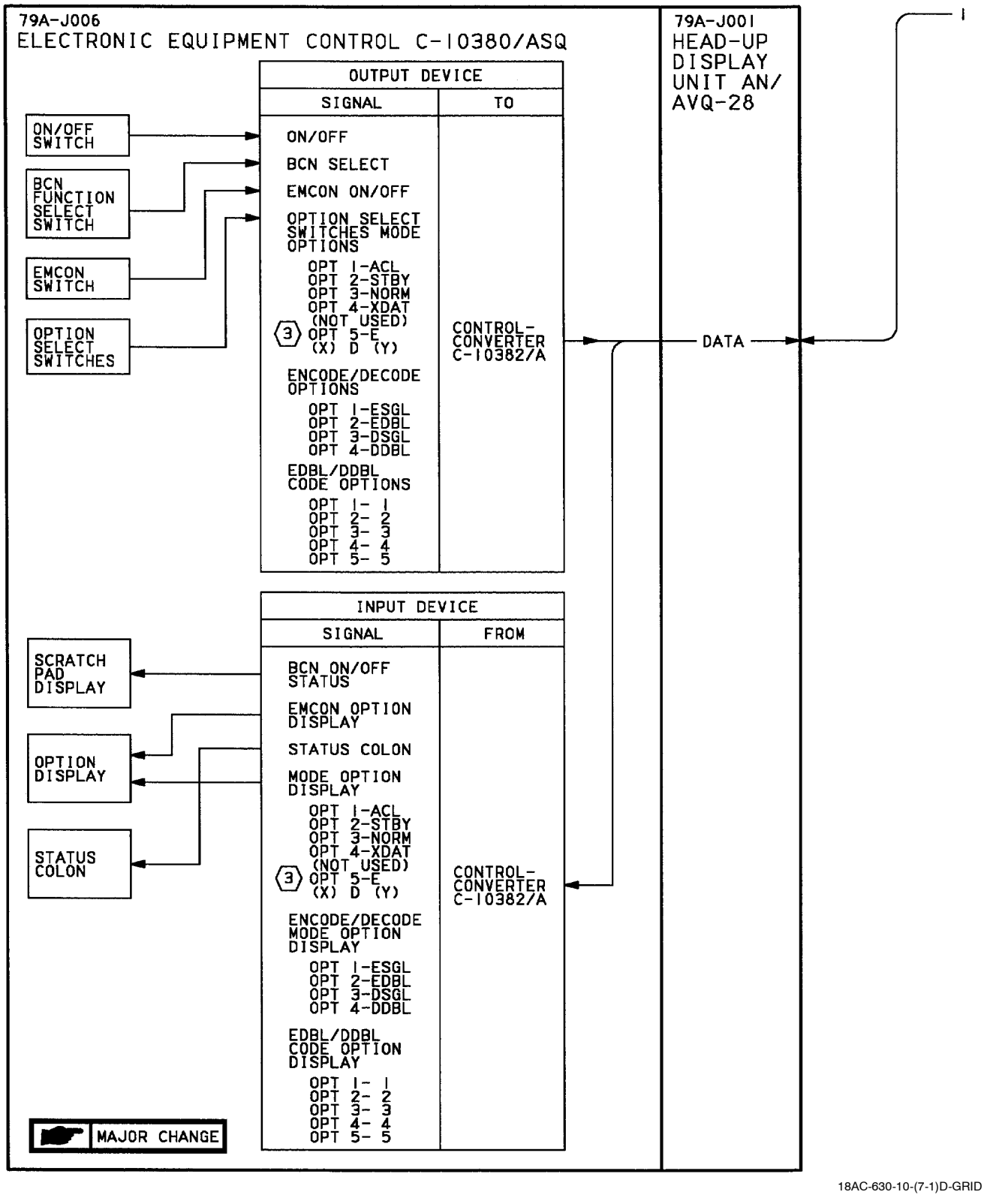
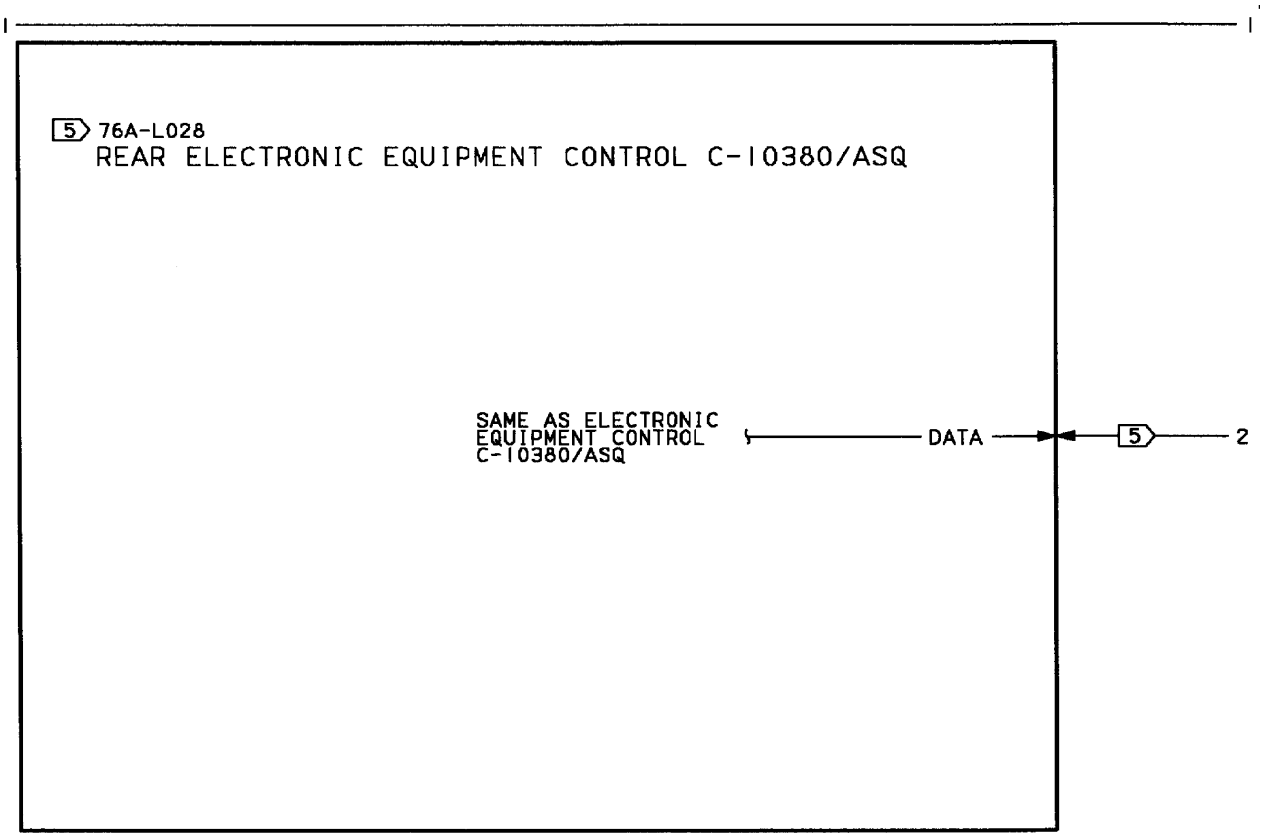


Figure 1. Radar Beacon System Simplified Schematic (Sheet 1)



MAJOR CHANGE

18AC-630-10-(7-2)D-GRID

Figure 1. Radar Beacon System Simplified Schematic (Sheet 2)

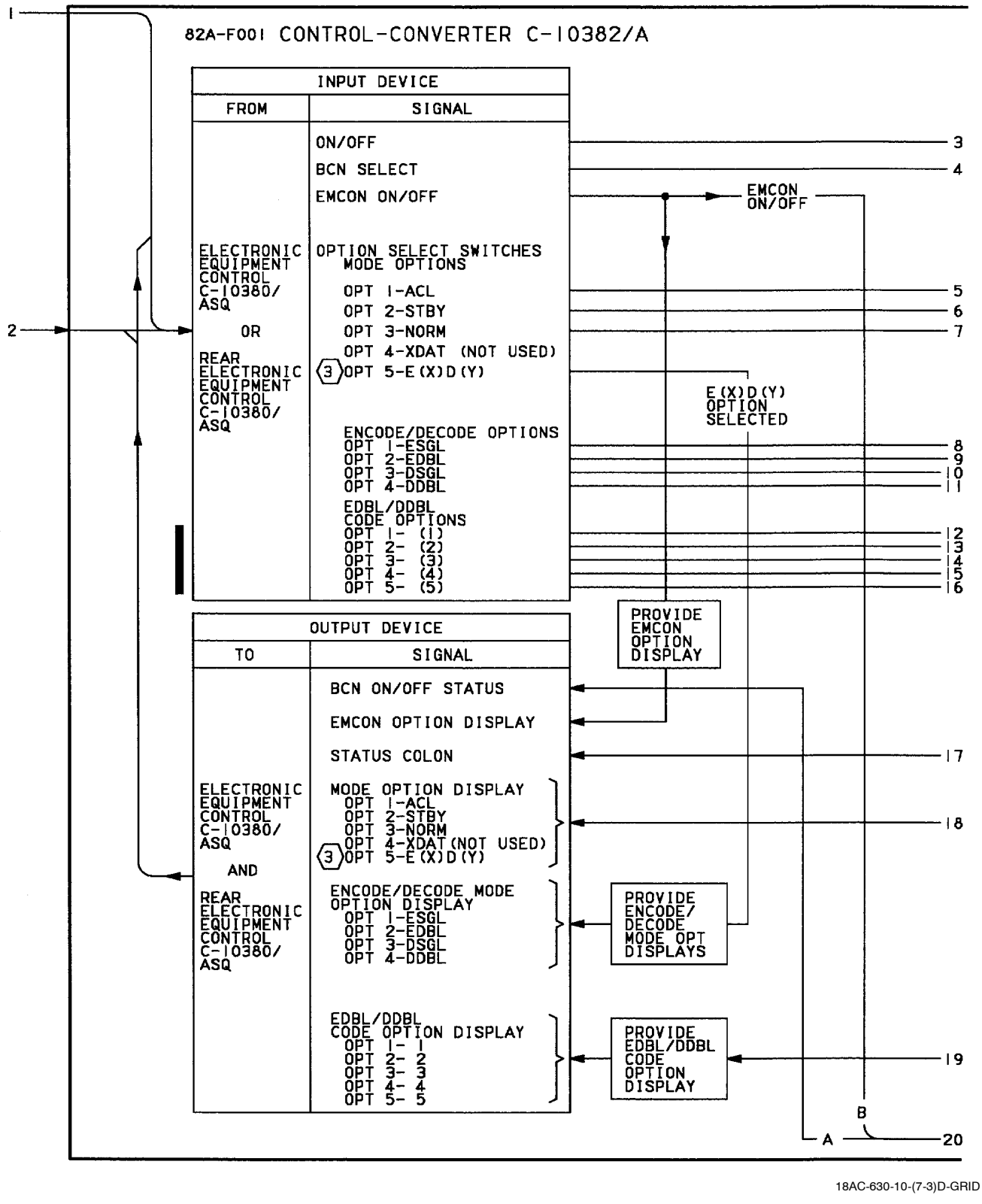


Figure 1. Radar Beacon System Simplified Schematic (Sheet 3)

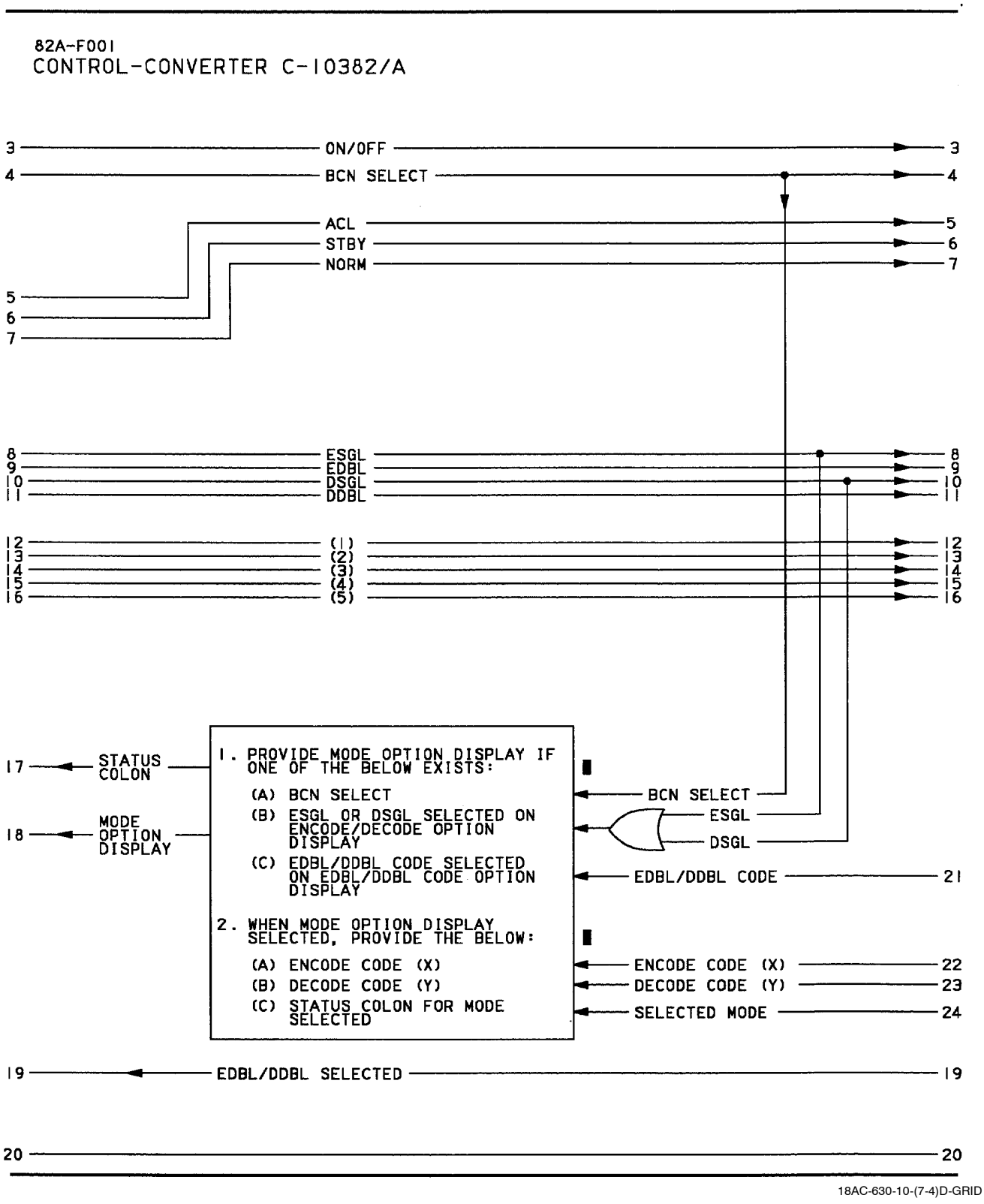


Figure 1. Radar Beacon System Simplified Schematic (Sheet 4)

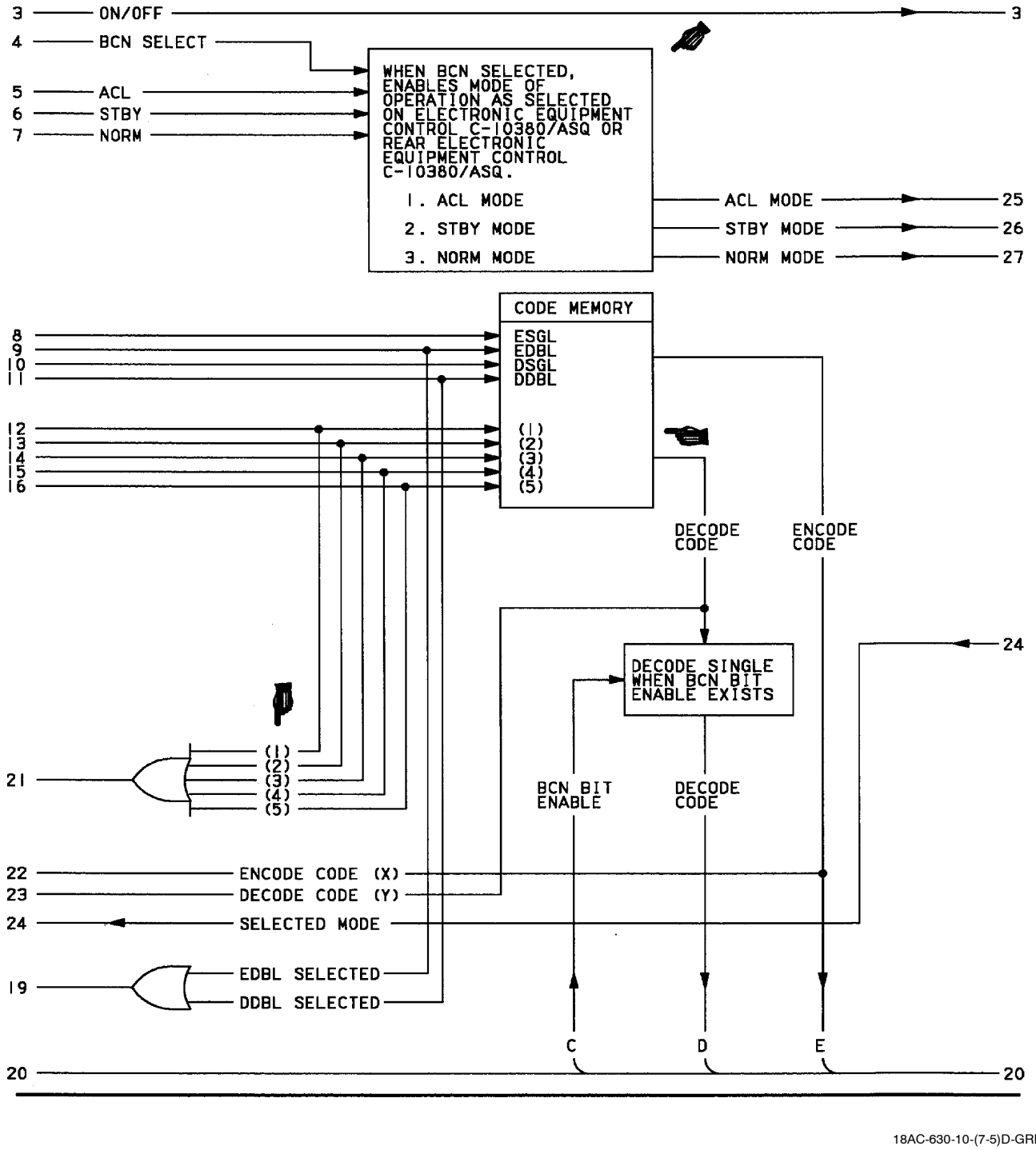
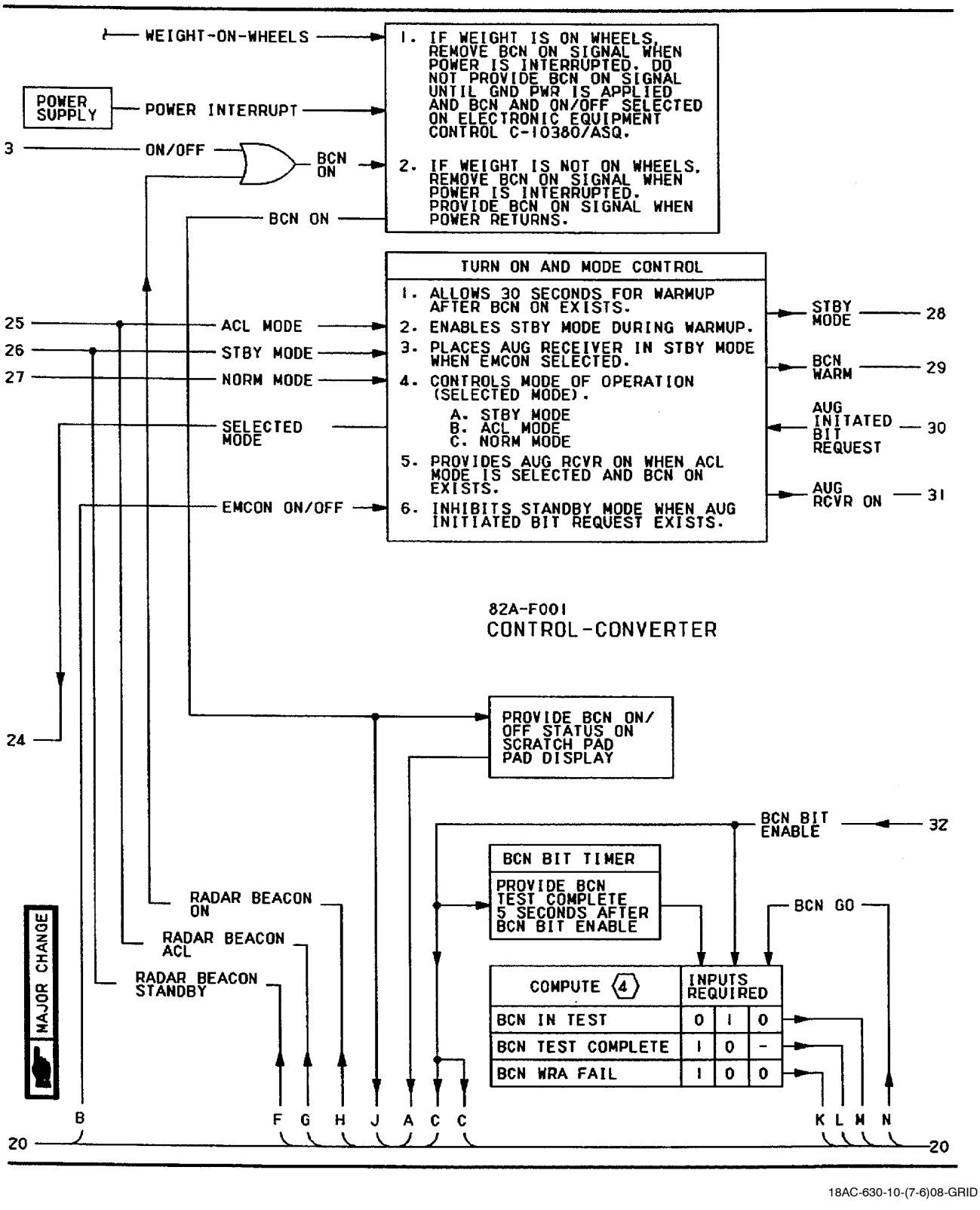


Figure 1. Radar Beacon System Simplified Schematic (Sheet 5)



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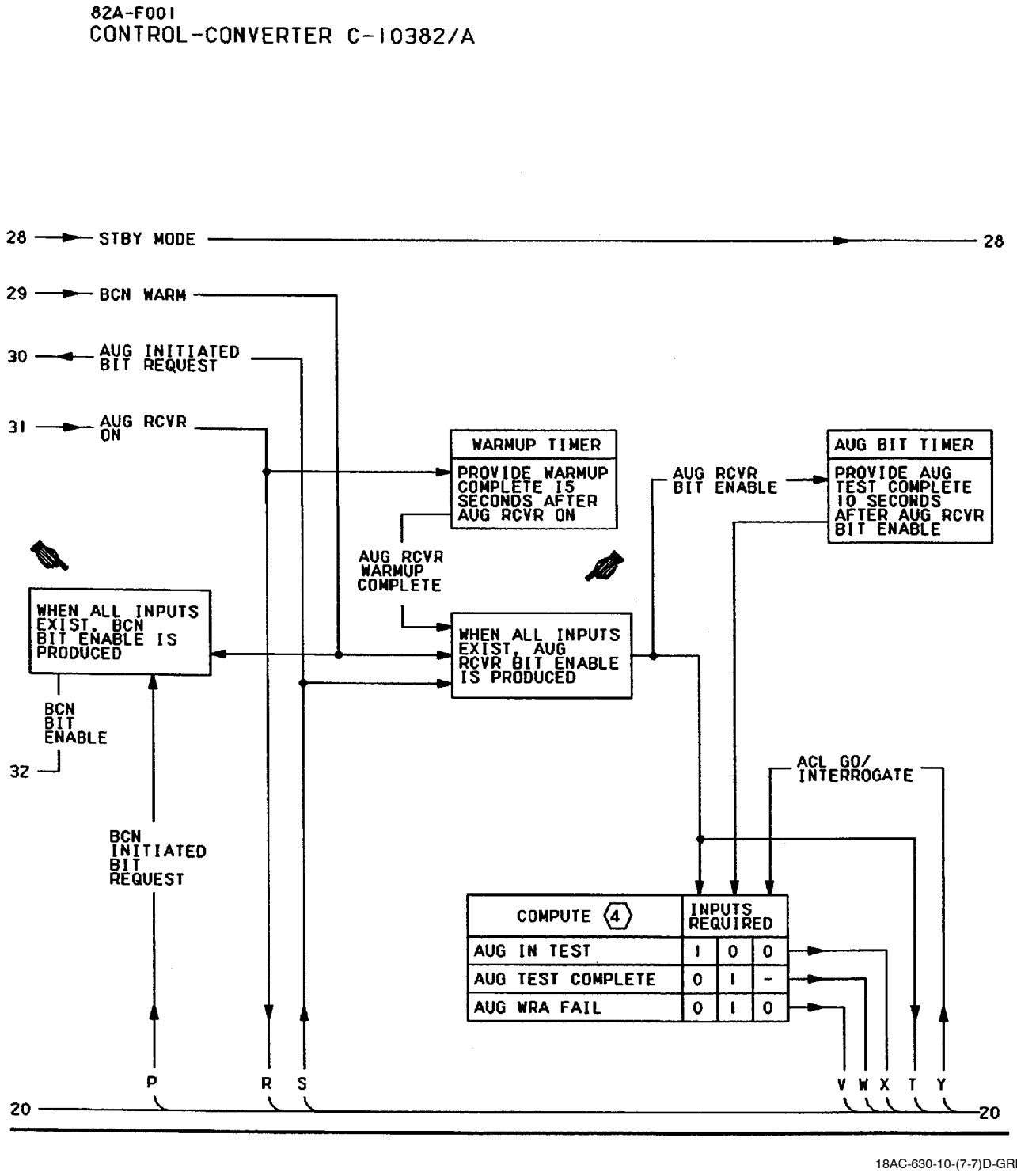

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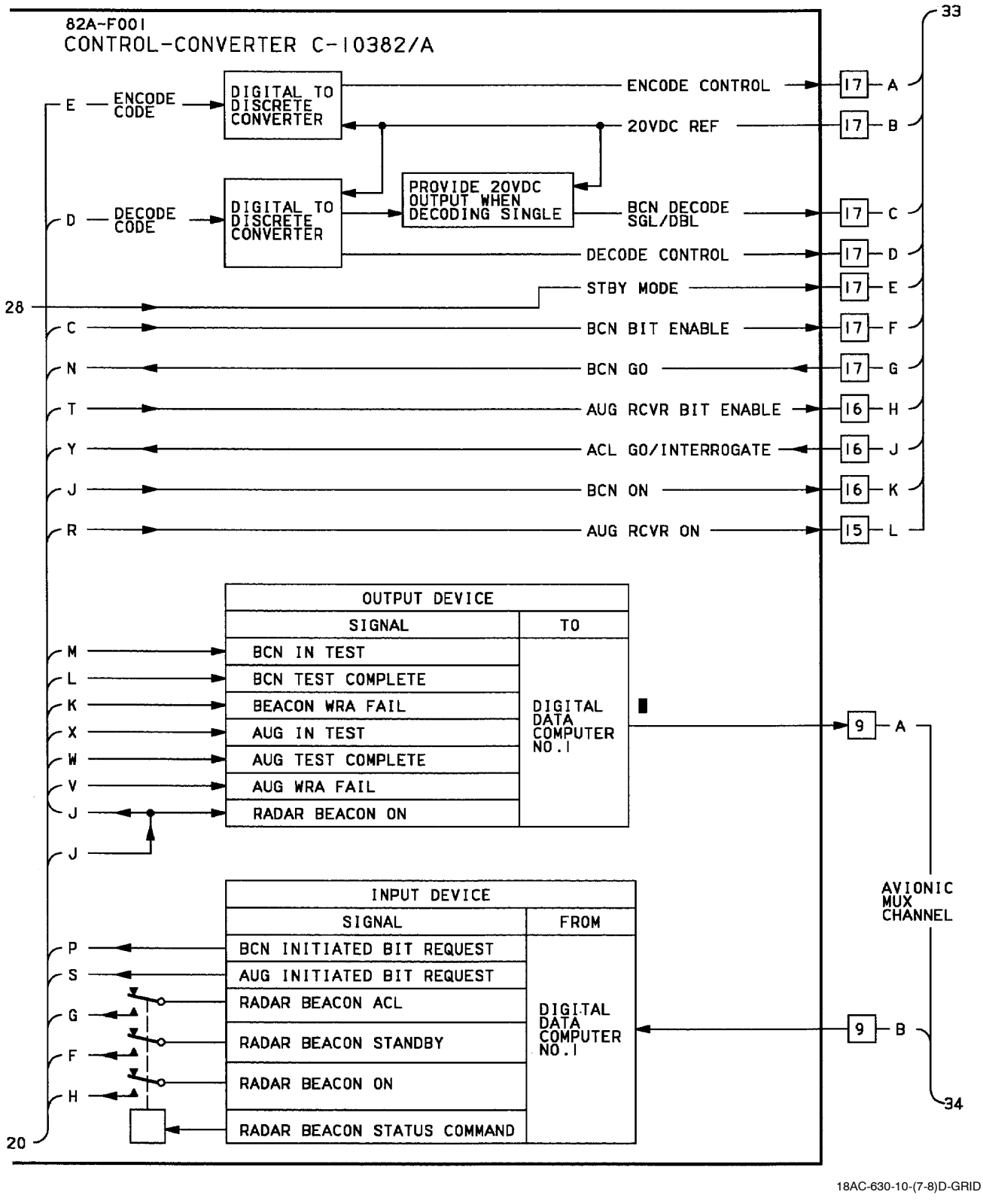


Figure 1. Radar Beacon System Simplified Schematic (Sheet 8)

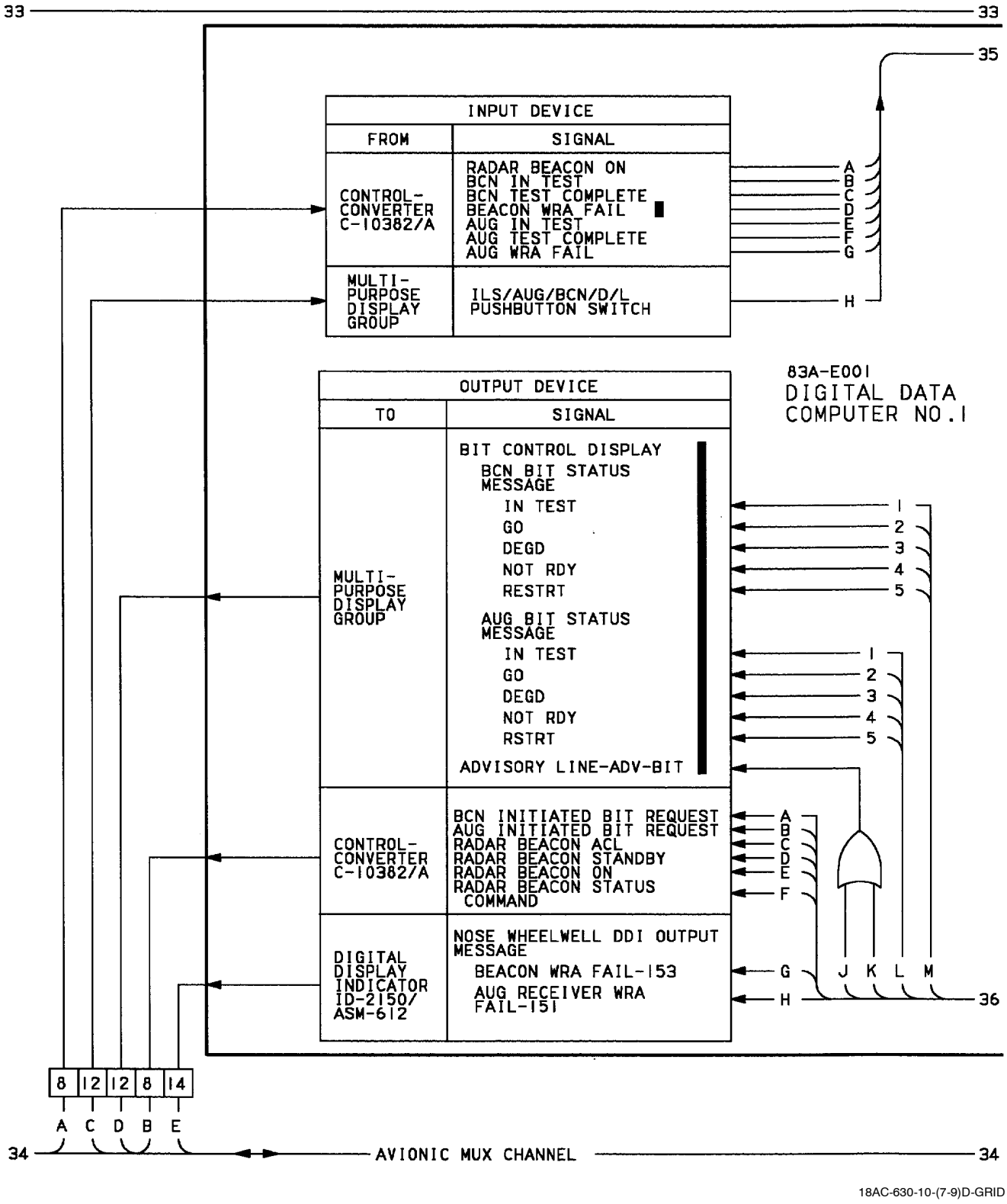


Figure 1. Radar Beacon System Simplified Schematic (Sheet 9)

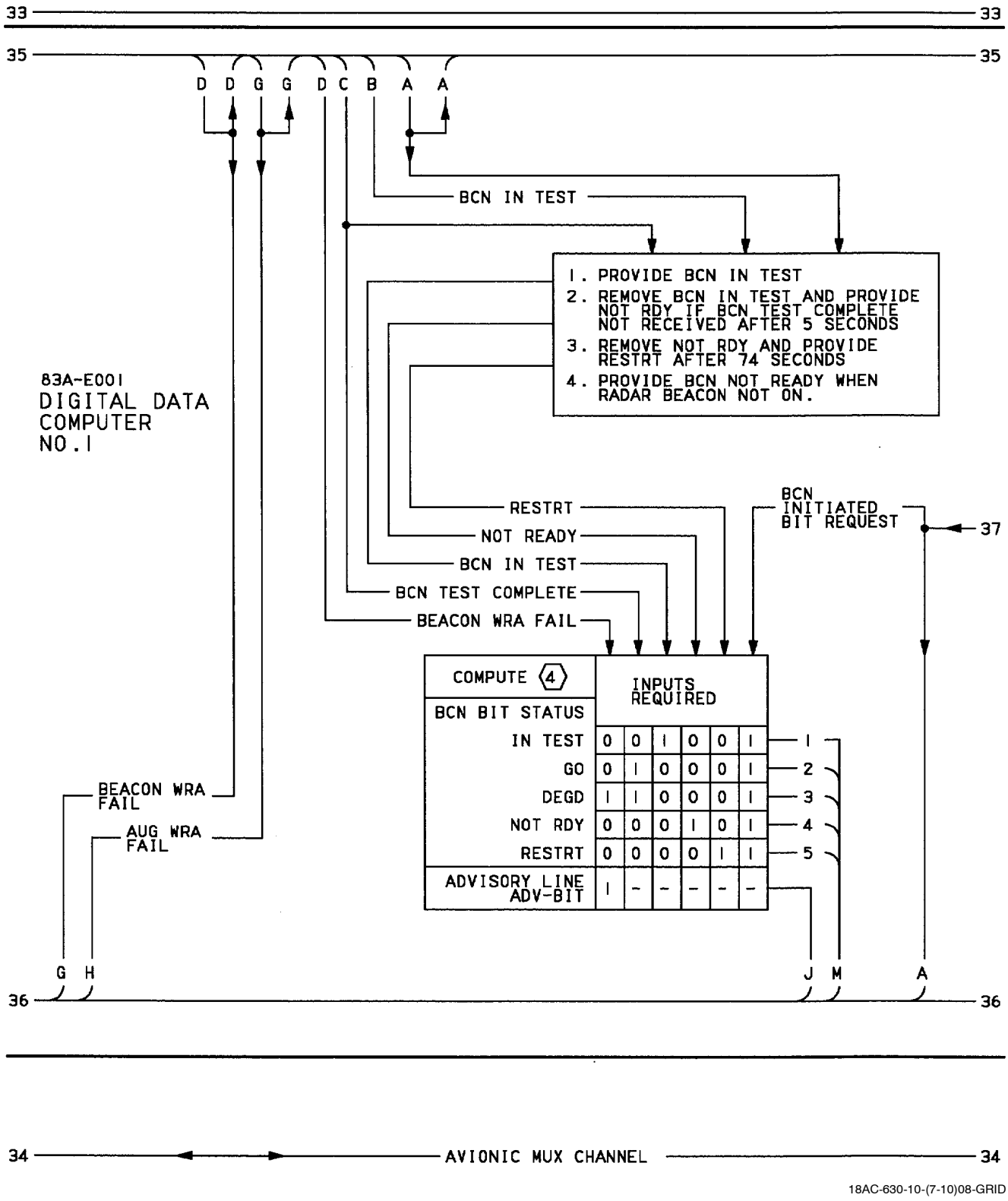
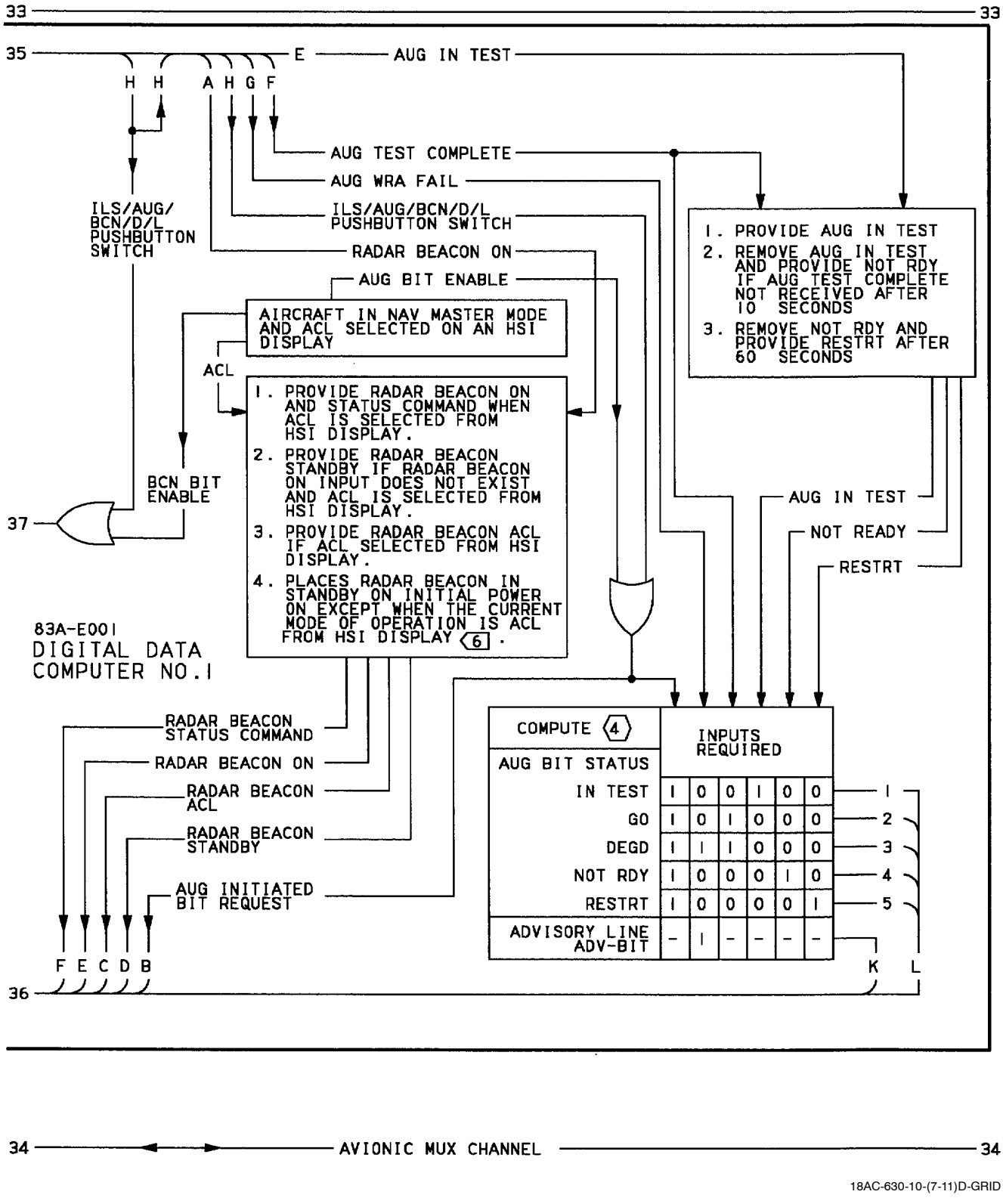


Figure 1. Radar Beacon System Simplified Schematic (Sheet 10)



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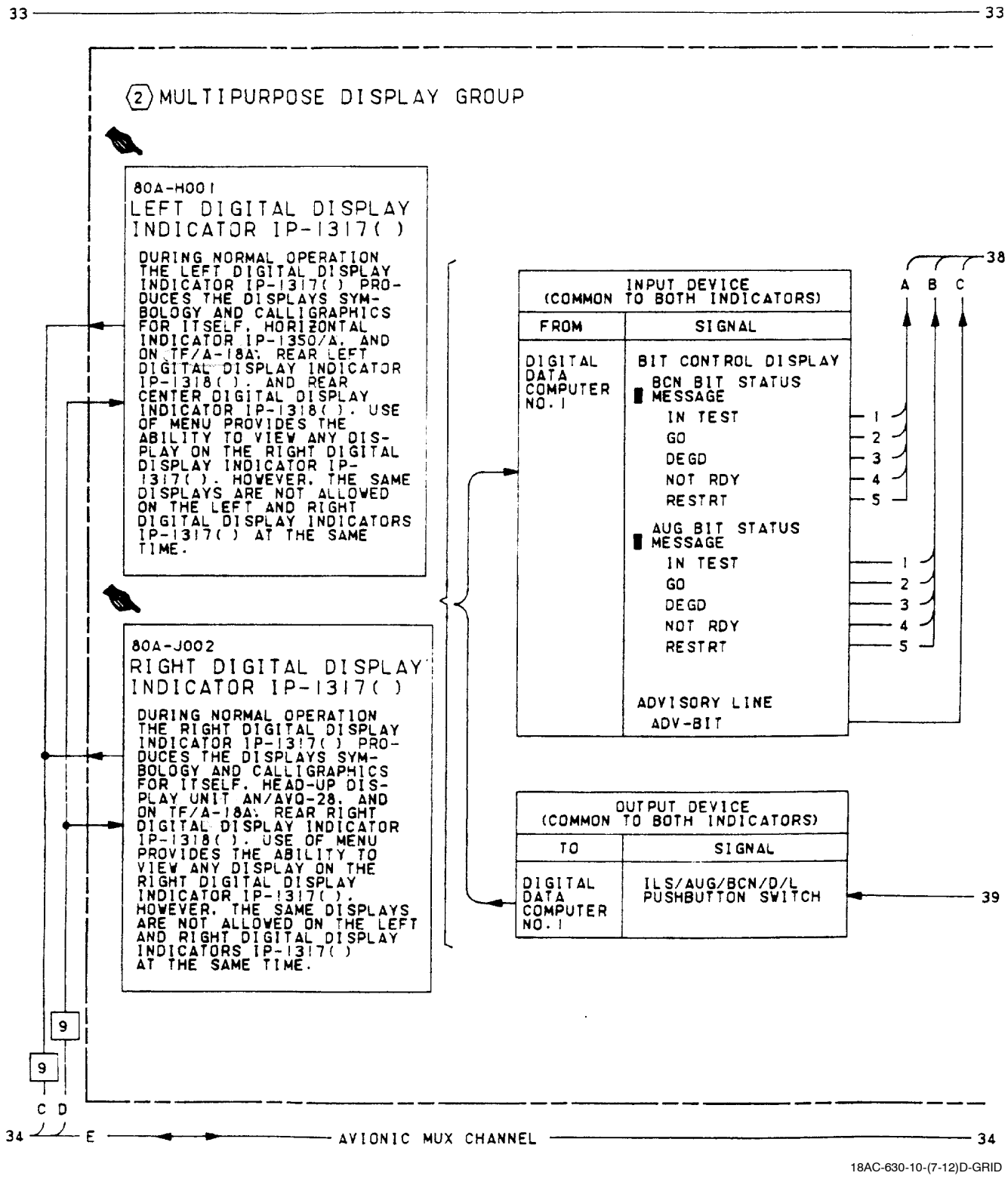


Figure 1. Radar Beacon System Simplified Schematic (Sheet 12)

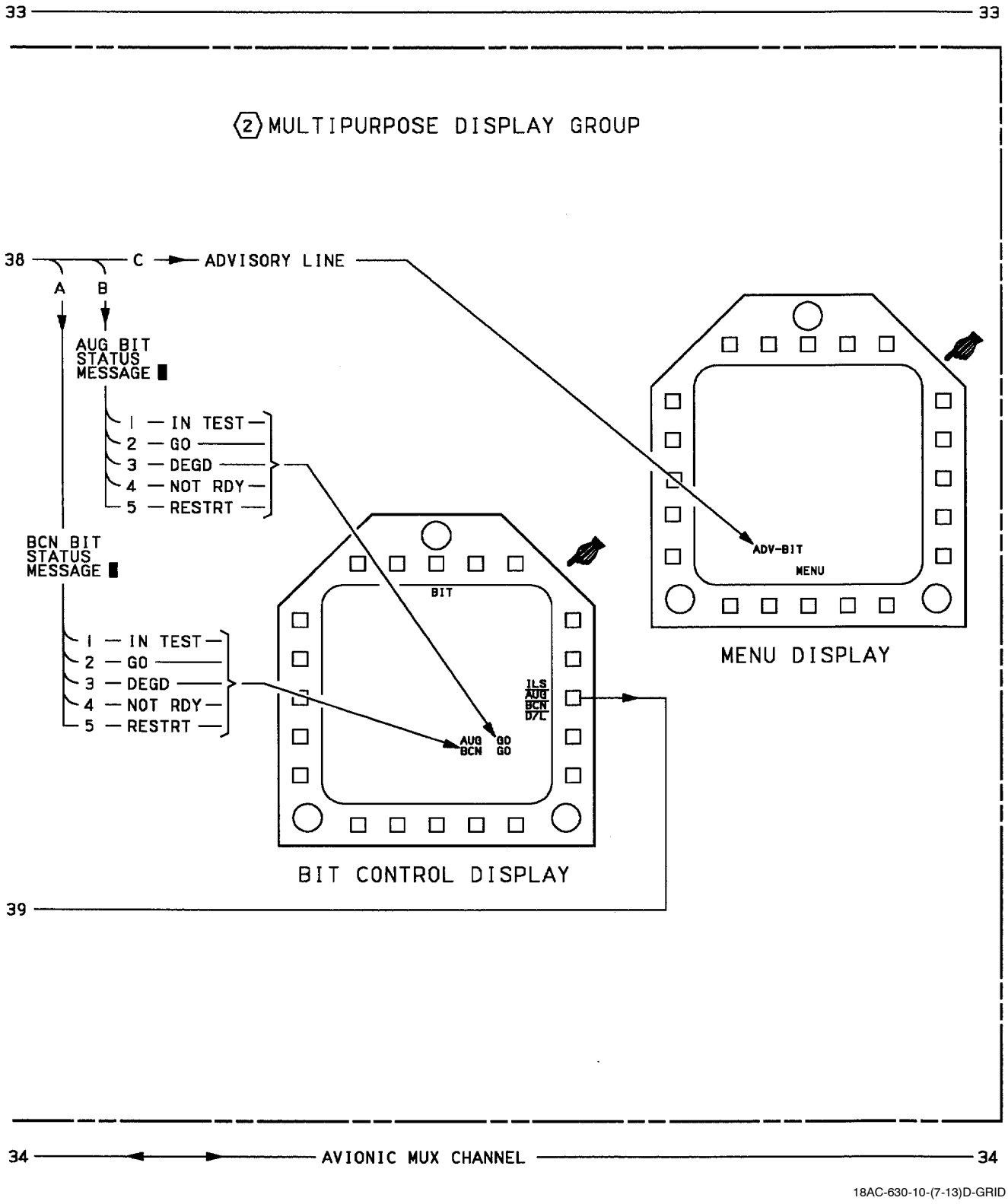


Figure 1. Radar Beacon System Simplified Schematic (Sheet 13)

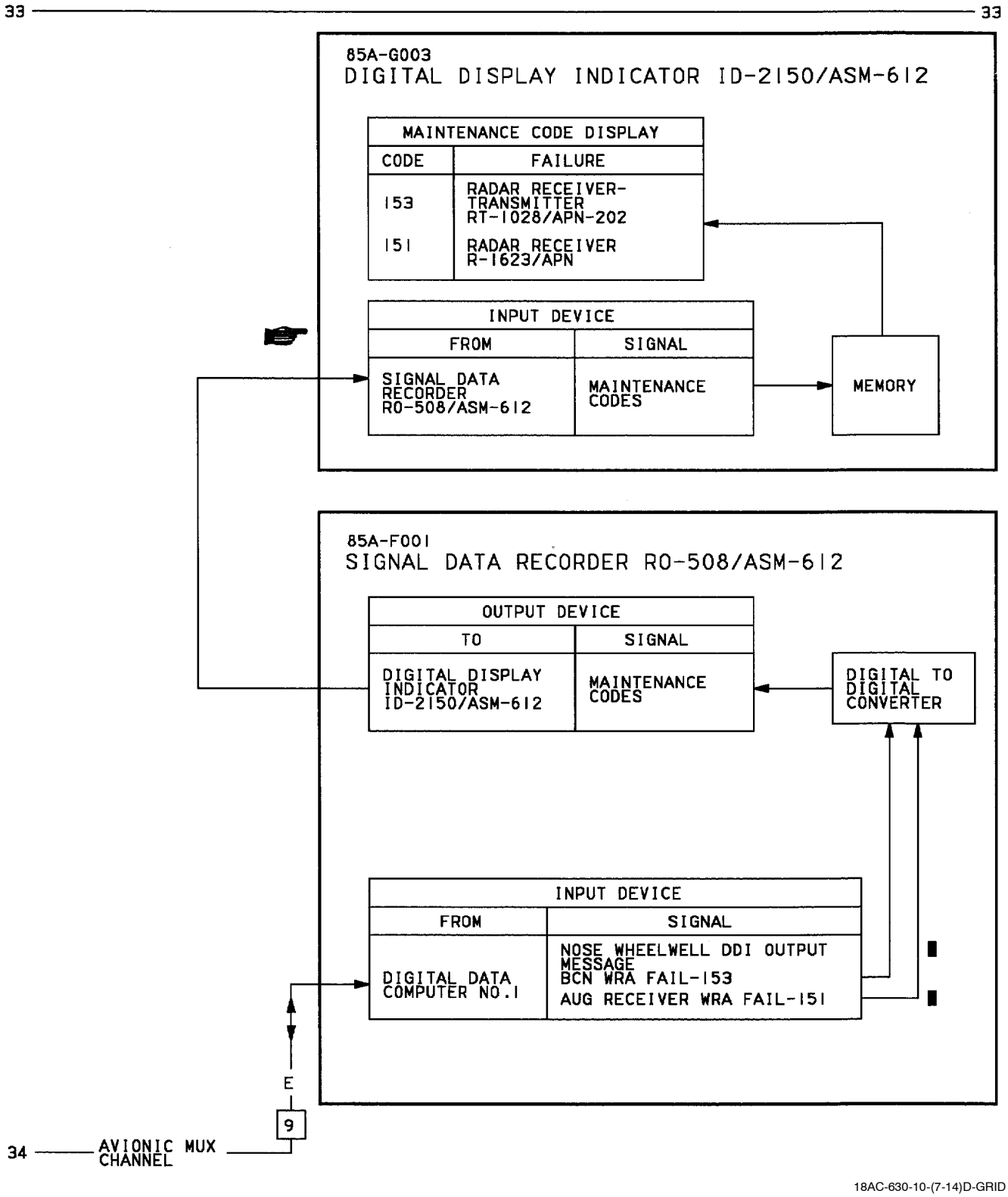


Figure 1. Radar Beacon System Simplified Schematic (Sheet 14)

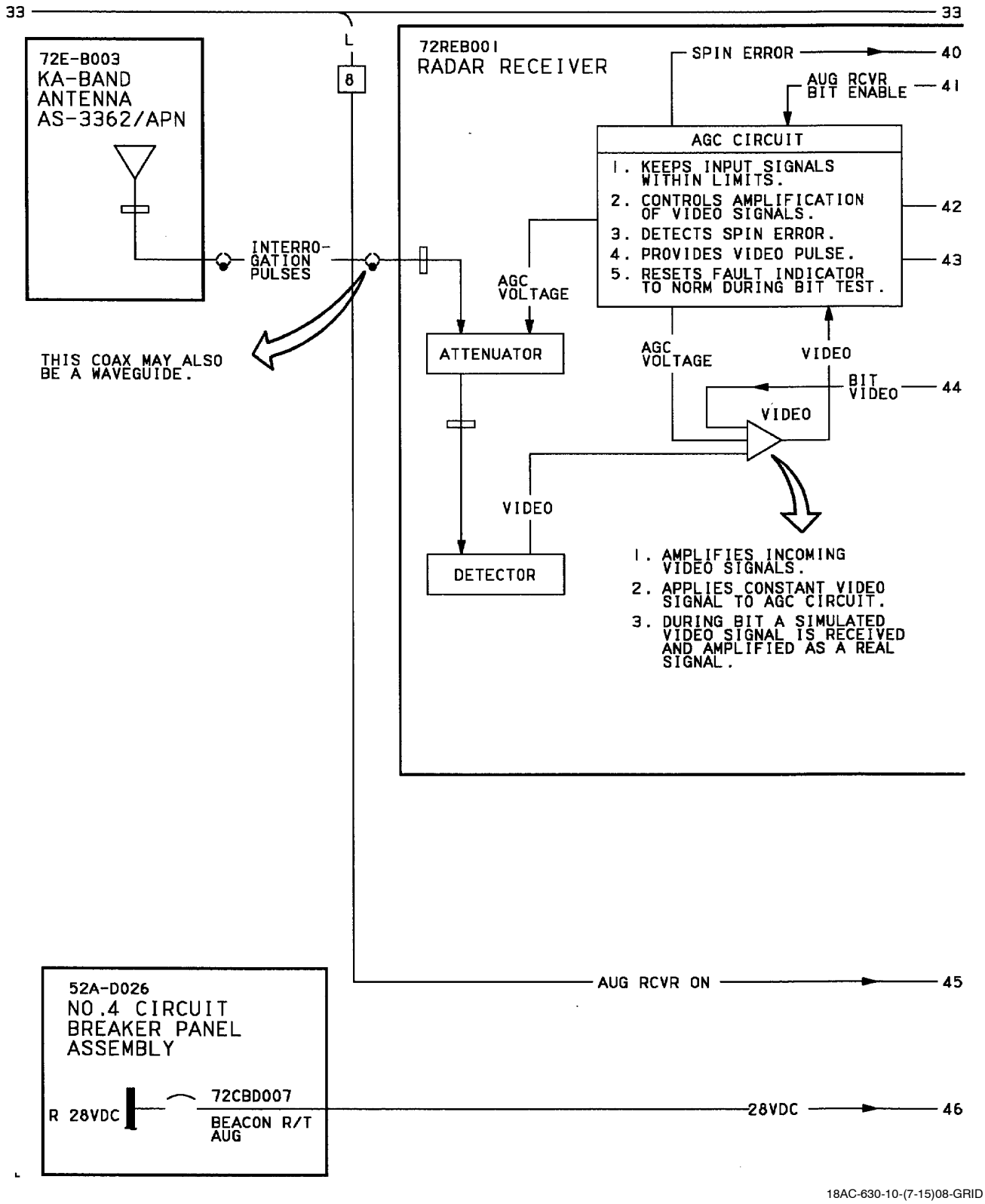


Figure 1. Radar Beacon System Simplified Schematic (Sheet 15)

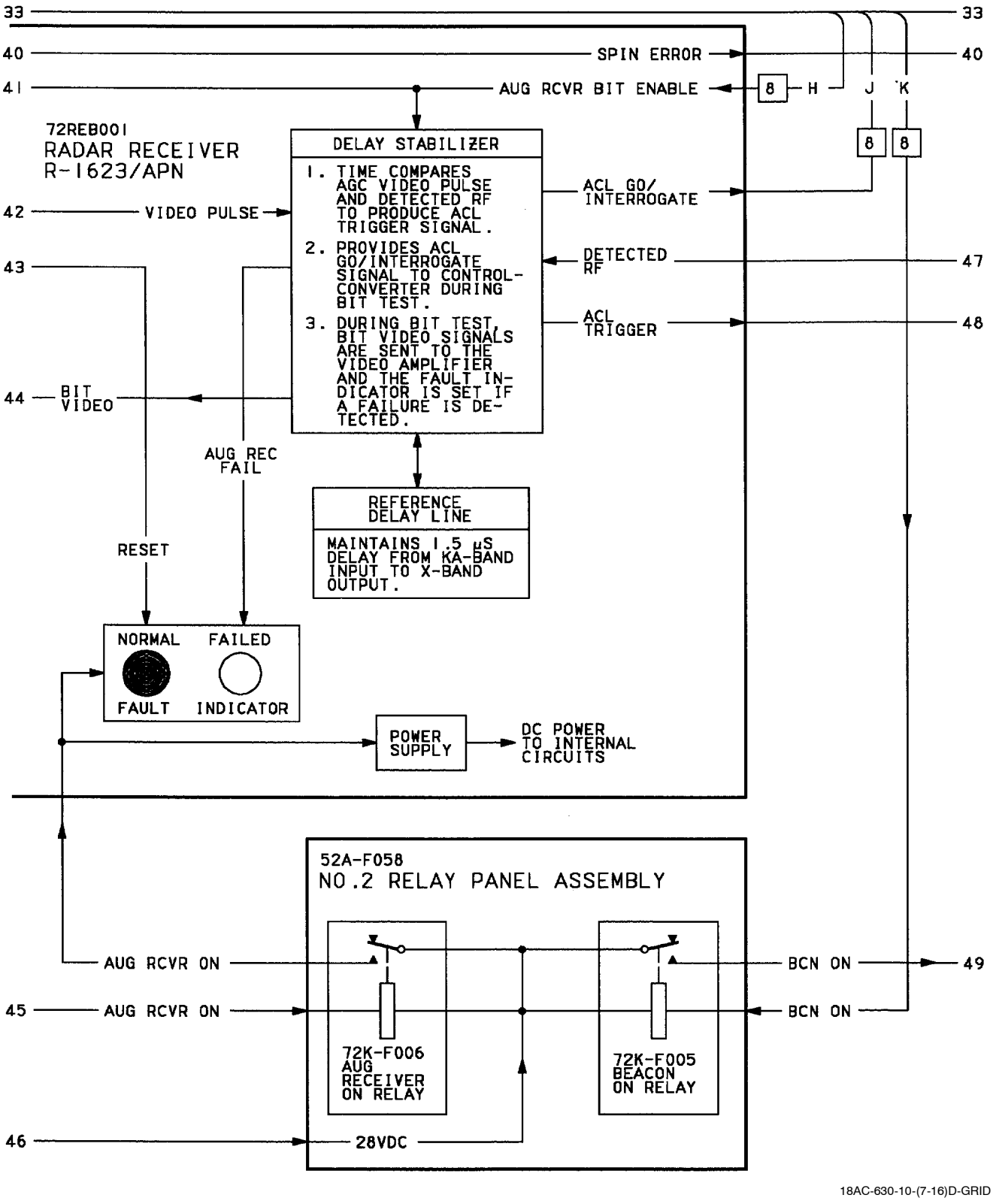


Figure 1. Radar Beacon System Simplified Schematic (Sheet 16)

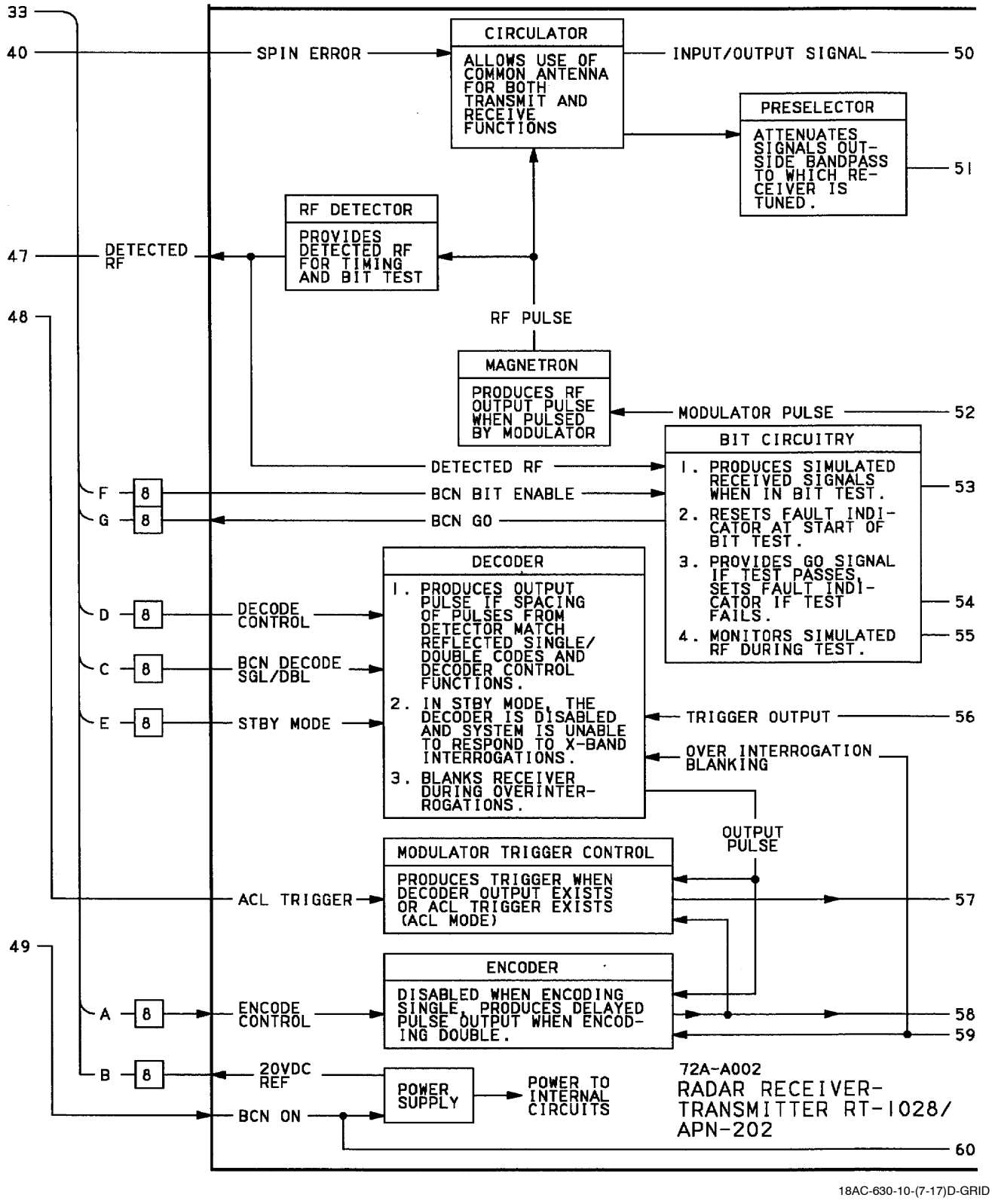


Figure 1. Radar Beacon System Simplified Schematic (Sheet 17)

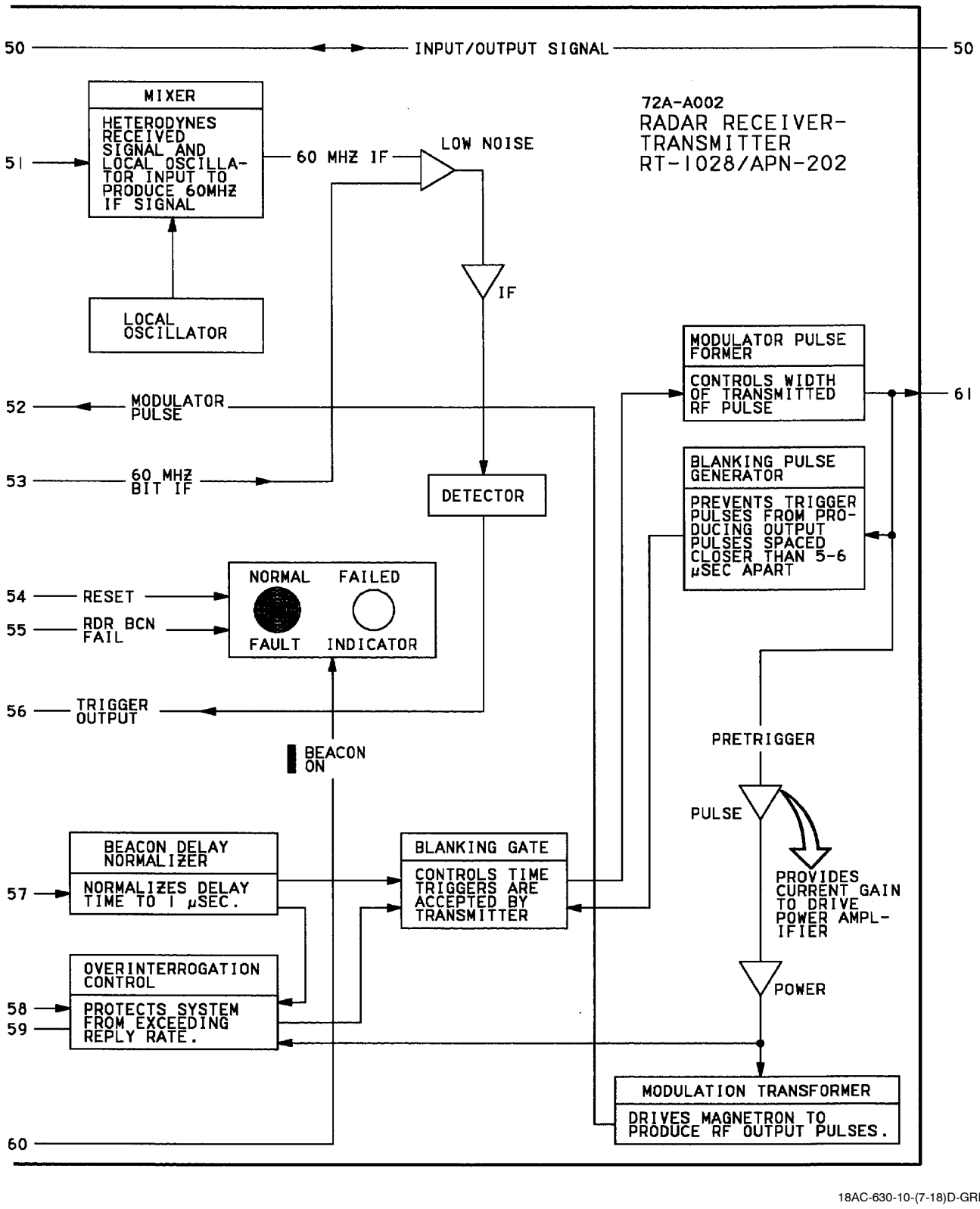
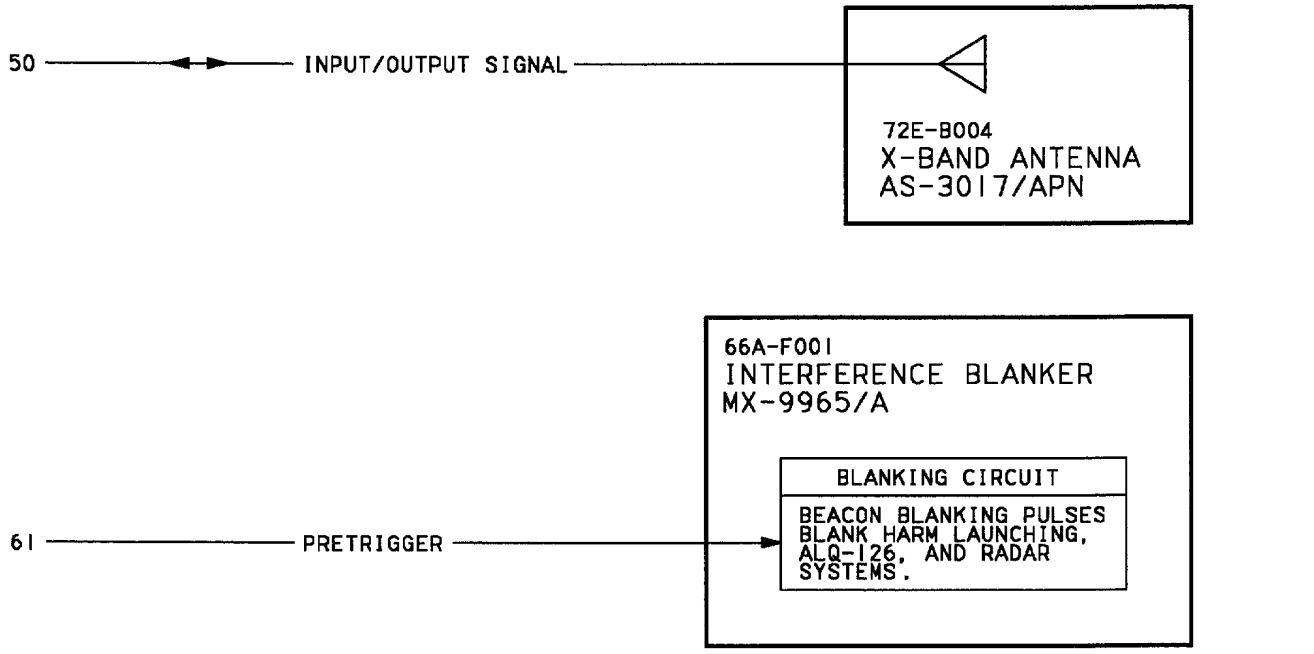
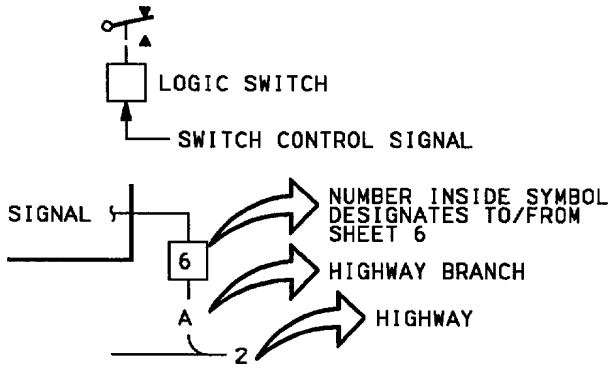


Figure 1. Radar Beacon System Simplified Schematic (Sheet 18)



LEGEND

1. NONSTANDARD SYMBOLS.



2 THE MULTIPURPOSE DISPLAY GROUP IS MADE UP OF THE LEFT DIGITAL DISPLAY INDICATOR IP-1317( ), RIGHT DIGITAL DISPLAY INDICATOR IP-1317( ), HEAD-UP DISPLAY UNIT AN/AVQ-28, HORIZONTAL INDICATOR IP-1350/A, AND ON TF/A-18A THE REAR LEFT DIGITAL DISPLAY INDICATOR IP-1318( ) REAR RIGHT DIGITAL DISPLAY INDICATOR IP-1318( ), AND REAR CENTER DIGITAL DISPLAY INDICATOR IP-1318( ).

(3) (X) INDICATES THE ENCODE CODE BEING USED
(Y) INDICATES THE DECODE CODE BEING USED

(4) EXPLANATION OF MATRIX:

A. COMPUTE COLUMN LISTS THE SIGNAL OUTPUT.

B. INPUTS REQUIRED ARE USED TO DEVELOP THE SIGNAL OUTPUT.

C. THE SIGNAL OUTPUT IS READ HORIZONTALLY. EACH HORIZONTAL LINE IS AN INDEPENDENT SIGNAL OUTPUT.

D. INTERPRET MATRIX TABLE AS INDICATED:

(1) ONE (1) INDICATES THIS INPUT AS NAMED MUST BE THERE TO GET THE OUTPUT.

(2) ZERO (0) INDICATES THIS INPUT AS NAMED MUST NOT BE THERE TO GET THE OUTPUT.

(3) DASH (-) INDICATES THE OUTPUT DOES NOT DEPEND ON THIS INPUT.

(5) TF/A-18A.

(6) WITH DIGITAL DATA COMPUTER NO.1 CONFIG/IDENT NO.84A AND UP (A1-F18AC-SCM-000).

18AC-630-10-(7-19)D-GRID

Figure 1. Radar Beacon System Simplified Schematic (Sheet 19)